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ENGINEERING NEWS.

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THE MULTIFOLD WATER FILTER.

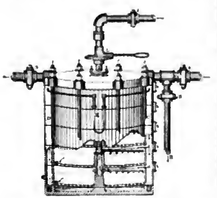
The subject of pure water is one in which all are interested, and any suggestions leading to a solution of the much discussed and we may say much abused question, how to produce a permanent supply of pure water from sources which, owing to their location become polluted and contaminated by the addition of foul matter and substances liable to decompose under most conditions, will be of interest to scientists, engineers, cities, manufacturers and all consumers of water.

It is unnecessary to state that filtration through beds of sand or other separating mediums will greatly benefit and, in most cases, entirely purify water containing suspended matter. This is too thoroughly understood to require argument. The problem has been to reduce the space required by the old method of sand bed filtration to a minimum, to cleanse the filtering beds of accumulated silt, which retards and would ultimately prevent the passage of water, and to accomplish these results on a large scale and at small cost.

The answer to this problem is pretty thoroughly embodied in the Multifold Filter, manufactured and sold by The Newark Filtering Co., at 177 Commerce street, Newark, N. J.

This filter is constructed on an entirely new and novel plan, and is amply protected by letters patent in the United States and principal foreign countries.

This filter derives its name from its construction, the filtering area on a given ground space being increased or multiplied by placing a number of cylindrical compartments or beds one above the other.



These beds are of cast and wrought iron, and vary in diameter from 20 to 96 inches and in depth from 12 to 24 inches, according to the nature of the water and the degree of filtration required, the number of beds being varied to suit the required capacity. Thus is attained from three to ten times the filtering area and capacity obtained by any other method now in existence.

The filtering material is sustained in the compartments upon sheets of finely-perforated brass, manufactured under a new and patented process. These brass plates, which are supported at a proper distance from the bottom of bed, allow the free passage of water, but prevent the escape of sand. Water to be filtered is admitted through the valve *A* to the common inlet passage *C*, through the subordinate inlets *d* to the surfaces of the filter beds. In its passage through the filtering material the water becomes purified, passes through the spaces between the perforated brass and the bottoms, thence through the outlet ports *g* and *D* and valve *G*. The hand-hole plates *h* afford access to all parts.

Each compartment forms an independent filter bed, and all joined together in one apparatus by the bolts *f*, afford a large capacity on a small ground space.

When the filter needs cleaning the mercury gauge *K*, connecting with inlet and outlet, will indicate a resistance of 2 to 4 lbs. per square inch.

The method of cleansing or washing the filter beds forms another distinctive feature of this filter. It is accomplished by means of travelling jets of water applied to the beds through the radial washer pipes *b*, from the main vertical washer pipe *J*, which passes through all the compartments, at a sufficient pressure to thoroughly agitate all of the filter beds. The effect of this is to detach all of the impurities, which, being of inferior specific gravity, rise and pass with the water out of the filter through the ports *d* and waste outlet *E*. The semi-circular ribbed guards, or rippling plates, prevent the sand from escaping with the waste water.

Where two or more filters are used conjointly, the progress of filtration is not interrupted during the washing, and, in case a single filter is used, the interruption lasts but three or four minutes.

It is claimed that this filter obviates all of the difficulties experienced by other manufacturers; that it economises ground space; that it rapidly and effectually cleanses the filtering beds without the necessity of removing and replacing them; and that is applicable on a large scale.

The Multifold Filter will cleanse the water supply of the largest cities, and of paper mills, dye works, laundries, steam boilers, etc., and is adapted to both high and low pressure.

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ATTEMPTED LEGISLATION IN MICHIGAN IN RELATION TO SURVEYS.

ANN ARBOR, Mich., Dec. 29, 1881.

EDITOR ENGINEERING NEWS:

From time to time organizations of surveyors in several of the Western States have tried to secure the passage of such laws as they thought would improve the practice of surveying, and cut off incompetent persons, of whom there are many. The statement of the attempt and result in the Michigan legislature last winter may help our brethren towards a solution of the problem, as we can learn from other failures. I hope it may not be found too long for your columns.

Yours truly,

CHAS. E. GREENE.

The Michigan Association of Surveyors and Civil Engineers, at their second meeting, at Lansing, in January, 1881, appointed a committee to consider and report upon desired legislation, to provide for organizing the surveying service of the State; to secure uniformity of practice, use of standard measure, and for the more complete recording of surveys of a permanent nature. As surveyors in other States have been discussing the expediency of similar steps, it is not unlikely that they may learn something from the failure of the last trial by the Michigan Association to bring about a reform, and we therefore give the bill which was introduced into the Senate through the efforts of the above committee, Jan. 21, 1881, was reported without amendment by Committee on State Affairs, and passed the Senate with little opposition.

A Bill to establish a Board of Commissioners of Surveys, to prescribe their duties, and to fix their compensation; and to further provide for the public surveys.

Sec. 1. The People of the State of Michigan enact, That a State Board of Commissioners of Surveys is hereby established, to be composed of three members, each of whom shall have been for at least five years before his appointment a practical land surveyor within this State. The members of the board shall be appointed by the Governor, with the advice and consent of the Senate. The members first appointed shall be designated by the Governor—one for the term of office for two years, one for the term of office for four years, and one for the term of office for six years; and thereafter the Governor, with the advice and consent of the Senate, shall bi-annually appoint one member to hold his office for six years, ending May fifteenth. Any vacancy in said board may be filled until the regular session by the Governor.

Sec. 2. Each member of said board shall take the constitutional oath of office before some officer authorized to administer oaths, and shall enter into bonds with the people of the State of Michigan in the penal sum of three thousand dollars, with sureties to be approved by the Governor, conditioned for the faithful and impartial performance of the duties of his office, and shall file such bond and oath of office in the office of the Secretary of State.

Sec. 3. That member of the board whose term of office will soonest expire shall be the chairman thereof. The board, or a majority thereof, shall hold regular meetings at the State land office in Lansing on the last Wednesday of January in each year.

Sec. 4. The Commissioner of the State Land Office shall, at the first regular meeting of said board, designate one of the regular clerks of his office to act as secretary thereof. It shall be the duty of such secretary to attend the sittings of the board, to record its proceedings, to preserve its books, papers and property, attend to its correspondence, and perform such other duties as may be required of him by said board.

Sec. 5. The board shall be a board of examiners, and shall make public examinations of persons for land surveyors. Every person desiring to practice as a land surveyor within this State shall give notice to the secretary of the board at least two weeks previous to a regular meeting thereof; and at the meeting designated such applicant shall appear in person, and, when required by the board, bring his instruments; and previous to such examination shall satisfy the board that he is a person of probity and sobriety.

Sec. 6. The board shall examine such applicant with regard to his proficiency in mathematics as applied to surveying, the United States public land system, the adjustment of instruments, map-drawing and the recording of surveys, and with special reference to the actual practice of the applicant in the field, his previous preparation and experience, and may require the applicant to perform such practical operations in their presence as they may deem necessary.

Sec. 7. The board, after being satisfied of the ability of the applicant, as provided in section six of this act, and of the sufficiency and correctness of his instruments, and, after such applicant shall have taken the constitutional oath of office and paid into the treasury of the State of Michigan the sum of five dollars, shall make and deliver to him a certificate in the following form, to wit:

This is to certify that ——, of ——, in the County of ——, in the State of Michigan, has duly passed his examination before the State Board of Commissioners of Surveys of the State of Michigan, and has been found qualified to perform the duties of land surveyor. Wherefore, the said —— is hereby authorized to practice as a land surveyor, with authority to take testimony in all matters pertaining to his profession, and administer oaths to his assistants within and in any part of the State of Michigan until this appointment and authority shall be revoked.

[Signed] —— —— —— } Board of Commissioners of Surveys.

But said board of commissioners, if they find an applicant is not sufficiently qualified, or, if from his inexperience in the field he does not seem to have sufficient practical acquaintance with his profession, shall encourage him to prepare himself for further examination.

Sec. 8. The secretary of the board shall, before the delivery of any such certificate, make a record thereof. Any surveyor holding such certificate shall be deemed a registered surveyor, within the meaning of this act.

Sec. 9. The board shall revoke the appointment of any registered surveyor whom they may find guilty of gross negligence or corruption in the execution of the duties of his office; but not without having previously summoned him to appear, in order to be heard in his defense, nor without having heard the evidence offered either in support of the complaint or in behalf of the surveyor inculpated.

Sec. 10. The board shall send to the County Clerk of each county at the close of each regular meeting a list of the names of all surveyors to-whom they have at such meeting granted certificates, and of those whose appointments have been at that time revoked.

Sec. 11. The board of commissioners of surveys is hereby required to provide itself at the expense of the State with suitable standards of length from the office of the United States Inspector of Weights and Measures.

Sec. 12. Every registered surveyor shall provide himself with a standard of lineal measures, which shall be certified by the secretary of the board, or by the United States Inspector of Weights and Measures, as being correct with the U. S. standard of length, and he shall keep his chains and tapes used in agreement with such standard.

Sec. 13. The board of commissioners of surveys shall be an advisory board on questions of boundary, extinct or disputed corners, and all difficult questions of surveying practice submitted to them by registered surveyors.

Sec. 14. The said board shall endeavor to secure uniformity in the practice of registered surveyors; and in re-establishing and perpetuating the United States surveys, they shall endeavor to conform to the plan on which these surveys were made, to the end that lost corners and lines may be re-established in their original positions.

Sec. 15. Each member of the board of commissioners of surveys shall receive ten cents a mile for each mile necessarily traveled in going to and returning from their place of meeting at the capitol at Lansing, and his necessary expenses during the session of said board; said mileage and expenses shall be allowed by the Board of Auditors and paid by the State Treasurer on the warrant of the Auditor General. The necessary expenses of said board for stationery and instruments for their office and for their secretary while engaged in the performance of his duties shall be audited and allowed by the Board of State Auditors and paid by the State Treasurer on the warrant of the Auditor General.

Sec. 16. Each registered surveyor shall keep a full and complete record of surveys made by him in a book of such form and size as shall be prescribed by the board of commissioners of surveys, and within ten days previous to the first day of January of each year, shall, at his own expense, deposit said record in the office of the County Surveyor of the county in which the surveys were made, and each county surveyor receiving such record shall give to the person depositing the same a receipt therefor; but no record shall be received by such county surveyors unless made by a registered surveyor whose certificate, as shown by the list on file in the County Clerk's office, was in full force at the time the survey was made. The expense of making a record of any surveys made by a registered surveyor shall be paid by the persons for whom the survey was made in proportion to the amount of work done for each.

Sec. 17. The record, or a certified transcript thereof of any survey made by such registered surveyors, shall be received as presumptive evidence of the facts therein set forth in all courts of record in this State.

Sec. 18. Whenever a majority of the resident owners of any section, or part or parts of any section of land in this State shall desire to have their corners or lines, or any of them, established, located, or perpetuated, they may apply to a registered surveyor to make the required surveys, who shall immediately give to the applicant a notice, who is hereby required to serve the same on all other persons owning land in the same section, or to their agents residing in the same township, informing them that at a day mentioned, not less than ten days from the date of the notice, the required surveys will be made.

Sec. 19. The registered surveyor, being satisfied that notice has been given, and no injustice will be done the parties not signing the application, shall make the surveys asked for; and the expense thereof shall be borne by all the persons benefited in proportion to the work done for each, to be determined by the surveyor; and if any person thus benefited shall refuse or neglect to pay his share of such expense, such surveyor shall certify the same, and to whom due, to the supervisor of the proper township, who shall assess it upon the land of such person, to be collected in the same manner as other taxes, and held subject to the order of the person named in the surveyor's certificate as being entitled to the same: *Provided*, In such cases the surveyor shall not charge to exceed four dollars a day, including the time of traveling to and from the place of making the survey and of making record of the same.

Sec. 20. No registered surveyor shall be liable to prosecution in an action of trespass for entering upon any lands in the discharge of his duties.

This bill, after passing the Senate, was introduced in the House and referred to the Committee on Geological Survey, who later made a report giving the following objections:

1. Section 1 creates a board of three additional State officers, with various but no useful or important duties. No other State officers can perform their duties or receive the appointments, as the bill provides that they shall be practical surveyors of at least five years' experience. This board is by this bill granted power, in sections 11 and 15, to provide instruments, some of which may be very costly, to be paid for out of the treasury of the State, and there is no provision controlling or limiting this dangerous power to be found in this bill. And your committee are of the opinion that it is unwise and impolitic for this Legislature to create a board of three additional State officers with no better prospects of returning profits than are afforded by the provisions of this bill.

2. The bill is unjust to the surveyors of the State. Section 3 provides that any person wishing to practice as a registered surveyor must first give notice to the board and then come to Lansing and be examined; and as the board meets only in midwinter, the whole upper peninsula would be excluded from the benefits of the bill or be subjected to great cost, as well as all other distant parts of the State. Again, section 7 prescribes the form of certificate which shall be granted, which is liable to deceive the holder, as it declares that he has authority to take testimony and administer oaths, while nowhere in the bill is there granted even the power to swear a flagman—no, not even to swear at him.

3. This bill does not provide for making surveys according to the laws of the State. Section 14 provides that the board shall endeavor to secure a uniformity of surveys, but does not provide that they shall be made in accordance with the laws of the State. And so with the records; the statutes provide a form for record of surveys, but this bill provides that a uniform record shall be prescribed by the board for registered surveyors, but fails to provide that it shall comply with the law of the State; and such record shall be filed with the county surveyor at the close of each year, thus making as many separate record books in the surveyor's office as there are surveyors working in his county, and these doubling each year as time goes on. This provision in the bill is very objectionable, causing, as it would, great confusion and trouble in preserving, and especially in finding, the records. Again, section 16 forbids county surveyors receiving any but the records of registered surveyors. This provision will be held as prohibiting the county surveyor from receiving the records of his own deputies.

4. Section 17 provides that the record of a registered surveyor shall be evidence in courts of records, yet the bill does not provide that either the survey or record shall be made in accordance with laws of the State. The statutes provide the manner of making surveys and records by county surveyors, and their record is evidence in all courts; so a court may be compelled by this bill to receive as evidence the record of a registered surveyor fixing a corner at a certain point, and also that of the county surveyor showing that it is 4 rods from there. Therefore this provision is extremely mischievous and objectionable.

5. Section 19 grants power to a registered surveyor to do work, and at his own discretion, and without appeal, to cause to be levied on your farms taxes that must be paid as he has apportioned them: and section 20 empowers him to enter your premises with impunity; and yet nowhere in this bill is there any provision that he shall give a bond for the just apportionment of your taxes, or that he will not do damage to your property while upon your premises. He has all the above powers and yet you cannot command his services, as there is no provision in this bill to compel him to make a survey unless he pleases, as is the case with county surveyors: not even a court can compel or command his services; he is by this bill above all law.

6. It is claimed by the surveyors' association who drafted this bill that it will secure greater accuracy and uniformity in making surveys, and in their records. But your committee find that the present statutes direct how surveys shall be made and also for a specific and uniform record of the same. Therefore this bill can be of no benefit in that direction, and if the board of surveys should prescribe a different method of making surveys or records, it could only produce conflict and confusion, and result in great harm to the service. And your committee would further report that they have thoroughly examined and carefully considered the numerous petitions and many letters for and against the adoption of the bill, and after such careful consideration your committee are of the opinion that the measure would be a needless expense to the State and a damage to the surveying service and to the surveyors themselves. Your committee therefore respectfully report the bill back to the House and recommend that it do not pass and ask to be discharged from the further consideration of the subject.

(Signed by the Committee.)

The report was accepted and the bill was then laid on the table.

* * *

Work is progressing on the railroad from Queretaro to Leon, Mexico, and several bridges are in course of construction.

CORRESPONDENCE.

WHAT IS RAILROAD GRADING?

St. Albans, Vt., Dec. 24, 1881.

Editor Engineering News:

I noticed on page 505 of your paper of the 17th inst. the question for railroad experts, "What is grading?"

An experience of many years in railroad construction and work has made me decidedly of the opinion that the term grading is confined to the various excavation from the cuts and constructing the embankments on a line of road, or, as the specification for the Vermont Central Railroad states it, "Under the head of grading shall be included all excavations and embankments required for the formation of the road-bed; all necessary turnouts; the preparation of depot grounds; all ditching and digging for foundations of all masonry." And the Ohio & Pennsylvania Railroad specifications have a similar definition of the term grading, as follows: "Grading includes all excavations and embankments required for the formation of the road-bed; cutting all ditches or drains or foundations of culverts; small bridges and walls, and the excavation necessary for reconstructing highways, turnpikes, or common roads connected with or incidental to the construction of said railroad."

The following railroads had the same definition of the term grading in their specifications: The Ohio & Mississippi; Pennsylvania; Baltimore & Ohio; Norfolk & Petersburg; Worcester & Nashua; Newburgh Branch of the N. Y. & Erie; Connecticut River; Hartford & New Haven; Cheshire.

In each of these cases they invariably make a separate statement concerning the masonry, and agree in their explanation as to what the term grading includes. I have never seen a specification that gave any other definition of that word than the above quoted, and so, if you please, you may set me down as a very positive believer in the correctness of it. Respectfully yours,

WM. E. BABBIT,
Chief Engineer C. V. R. R.

THE METRIC SYSTEM ON MEXICAN RAILWAYS (*PRO*).

Guanajuato, Mex., Dec. 8, 1881.

Editor Engineering News:

Some two years and a half ago I published in your valuable paper an article entitled *The Application of the Metric System in Laying Out Railroad Curves.*

At the time it did not attract much attention, but since the advent of railroad building here in Mexico, it is brought more into prominence.

Many engineers residing in the States at the time held up their hands in "holy horror" at the attempted innovation, and in language more terse than elegant swore they would never use the "new fangled" system in their practice.

Nor is this an exaggeration, for I was personally informed by an engineer (now dead) connected with the Mexican National Railroad, that had he known that the metric system was in use in Mexico, before leaving the United States, he certainly would have remained there. So much for prejudice. I do not want to call it by any harder name. A great many engineers of the same class were certainly astonished when on their arrival in Mexico (having accepted situations on the numerous lines now building), they discovered that the *Metric System* was prescribed by the Mexican government, and that they (the engineers) must use the same whether or no.

At the time of writing the article aforesaid, I little dreamed that it would be my fortune soon to practice what I preached. Before leaving the "States" I was not aware what system was in use there (here), never having given the subject any thought, other matters being uppermost in my mind at the time. When, after my arrival, I found that the metric system was the one to be employed, I did not manifest any displeasure at the discovery. Here was a chance to test the same practically, and thus ascertain whether it deserved the merit claimed for it or not.

But to the details of the same, as applied on the Mexican Central Railway, i. e., *Ferrocarril Central Mexicano*, as to the length of the chain. In my article I advocated (for peculiar reasons) a chain of 20 meters. The Mexican Central uses a chain of 25 meters in length, thus making 40 chains to the kilometer. Every meter is marked by a round tag with the appropriate number stamped thereon. Some of the chains are composed of 125 links, each 2 decimeters long, while others are 2.5 decimeters in length, making 100 links to the chain. I am at a loss to state which number is to be preferred, as peculiar advantages can be shown for either. I will, therefore, not attempt any discussion in favor of one, but let everybody "pay their money and take their choice." As the length of the chain is the basis of the chord employed in laying out the curves, therefore all radii are calculated for that length of chord (25 meters), these radii of course varying from those given in my article, I having assumed 20 meters as the length.

In running lines as practiced here, a stake is placed at the end of every chain, beginning at 1 and numbered consecutively, the limit of curve being the length of the survey.

Should it be necessary to put in an intermediate stake then the *plus* is indicated according to the number of meters from the last *station*. For instance, the last number is 28 and a stake is placed, say 12 meters in advance, then the stake is marked 28+12, which signifies *not* 28 meters plus 12 meters, but 28 stations plus 12 meters, or a total distance of 712 meters; the number of stations, 28, being mutiplied by 25, the length of a chain, and 12 meters then added. By mentally dividing by 4 the same result is obtained, as is apparent to every one.

In running curves the angles are deflected, as is usual, and according to the degree of curvature. The degree of curvature as in the United States is expressed by the center angle. I desire here to enter my protest against this method.

It would be far more desirable to express the degree of curvature by the deflection angle, that is, by the angle of deflection for one station, being one-half the center angle. It would simplify matters very much, and also be less liable to lead to mistakes, only one value being employed. As to profiles: The grade here is invariably expressed by the ratio of 1 to 100, or, in other words, so many per cent.; thus 1 per cent. being a rise (or fall) of 1 in 100, the rise (or fall) per station being thus always one-fourth of the percentage.

For profiles thus far the usual profile paper is being used, plate B, no paper ruled to metric values being obtainable.

The horizontal scale of the profile is taken at 100 meters per inch and the vertical scale at six meters per inch, making an exaggeration of 1 to 16⅔.

It would be desirable to have a profile paper ruled according to metric values, and I would offer the following suggestions to manufacturers of this class of engineering supplies:

Vertical lines one-half centimeters apart and every fourth line heavier than the rest. Horizontal lines $\frac{1}{10}$ centimeters apart and every tenth line heavier than the others. According to this division the paper would be divided into heavy squares having sides of two centimeters, representing horizontally 100 meters and vertically five meters, being a distortion of one to twenty; or the horizontal lines could be one-fourth centimeters apart and every alternate line a slightly heavier one and every sixteenth still heavier, thus giving the same sized squares, two centimeters, as the other division. But in this case two centimeters vertically would represent eight meters, making a distortion of 1 to 12.5.

It will be observed that the first division corresponds with the profile paper, plate *A*, now in use, being 400 ft. to an inch horizontally and 20 ft. to an inch vertically, a distortion of 1 to 20.

The second division does not differ materially from that of plate *B*, 400 ft. to an inch horizontally and 30 ft. to an inch vertically, a distortion of 1 to 13⅓.

For location of maps the usual scale is $\frac{1}{2500}$, each centimeter representing one chain or 25 meters. expressed in English measures this scale equals 208⅓ ft. to 1 in.

For leveling the ordinary target rod is used, being divided into meters, decimeters and centimeters. Millimeters are read by means of the target. The rod is generallly 3.5 meters long when extended, the lower part reading up to 2 meters and the upper part the additional 1.5 meters.

The above facts I have hastily thrown together in order to give a general idea of the practical workings of the system. At a future time I will discuss the subject more elaborately and go more into details. I also add the appended original table, showing relative values of the metric and English systems.

Table of curvature and radii for chords of 25 meters, showing also corresponding values expressed in chords of 100 ft., one meter assumed at 3.281 ft.:

Degree of curvature.	Radii in meters.	Degree of curvature.	Radii in feet.
30'	1,432.41	1° 13' 9"	4,699.74
1°	716.25	2° 26' 18"	2,350.05
1° 30'	477.52	3° 39' 28"	1,566.74
2	358.17	4° 52' 38"	1,175.16
2° 30'	286.57	6° 5' 45"	940.21
3	238.84	7° 19'	783.63
3° 30'	204.75	8° 32' 12"	671.78
4	179.19	9° 45' 38"	587.92
4° 30'	159.31	10° 59' 40"	522.70
5°	143.42	12° 11' 5"	470.56
5° 30	130.42	13° 25' 13"	427.91
6°	119.58	14° 3 ' 18"	392.34
6° 30	110.42	15° 54' 56"	362.29
7°	102.57	17° 5' 5"	336.53

Respectfully, EMILE LOW.

THE METRIC SYSTEM ON MEXICAN RAILWAYS (*CON*).

MEXICO, Dec. 6, 1881.

EDITOR ENGINEERING NEWS:

The metric system, which has been so much agitated of late, I have had some experience here in testing. So far as it applies to railroad engineering I have no doubt of the general beneficial results which will accrue from its use; but I have much doubt of its being in all cases so much superior to what is now in use in the "States," and I think engineers will regret the day if they ever give up the convenient one-hundred-foot chain for railroad work and the easy calculation that results from its use in curvature and earthwork, and also the feet graduation for railroad leveling.

I have, however, never heard the metric system advocated very much for railroad work, and so perhaps am merely setting up a man of straw to knock down. Here the metric system is obligatory on all the work in the republic; so it is not a matter of choice to be decided by the officers of the different roads. I do not know their private opinions, but give the conclusion arrived at by myself, and am ready to give reasons for the faith which is in me.

When coming to Mexico I was glad to hear that the metric system was there the lawful standard. Previously I had only taken a feeble interest in it, but had always thought that, like the dogmas of our religion, it was a good thing to have round, though I had spent but little thought in endeavoring to solve its mysteries. So I came here prejudiced in its favor, thinking the system would be a fine thing for railroad work. Why it has not been found to equal my expectations I will proceed to explain.

Our chain is twenty-five meters long, or eighty-two feet. Whether it would be better, as some have advocated, if in a length of twenty meters, I doubt, though that would be more convenient for curvature. Now, all curve work is necessarily easier with a cord of one hundred units, than with the number twenty-five or even twenty. If the chain was one hundred meters, of course it would be as convenient, but this would be too long for one; in other words, it would be impracticable. If the chain was ten meters, it would be handy as to the division, but would be too short, and no other length with one unit figure and ciphers can be had. Again, the half of twenty-five gives three figures to be used; of one hundred, only one. This is the alignment part. For leveling, the feet are at such distances, that the eye can go from one to another through the object glass of the level. Again, a tenth is a convenient size for all railroad work, nothing finer being required, except on turning points, when hundredths is sufficiently accurate—two decimals. On the meter rod the meters cannot be easily followed by the leveler while looking through the telescope, and mistakes have been made on that account. This would only be partially remedied by marking the meter in connection with each decimeter. To get ordinary ground two decimals must be used, The decimeter being too coarse, and for turning, three, the centimeter not being fine enough. In cross section work 50 ft. is sufficiently close, excepting particular breaks in the ground (and sometimes 100 ft. apart is near enough), one figure only being used in calculation. In the metric chain, if the full length is used, two figures, if the half, one, three, would have to be continually multiplied in summing up the earthwork. Respectfully, LAWRENCE BRADFORD.

* * *

RAILROAD TRAVELING IN GERMANY.

Whoever has enjoyed the comfortable and pleasant riding in the palace and parlor cars on some of the better American railways feels a distinct longing for them if chance ever takes him across the ocean, through any of the large foreign states. There, where the roads operate in densely settled districts, populous cities and numerous way-stations, *safety* is considered the principal component of the operating departments, and in the desire to further this cardinal feature of railroad management all other intentions—if any such ever existed—have become completely absorbed, so that now, while you are reasonably assured of a safe passage as contracted for, that is all you get, and all personal comforts and conveniences are generally neglected. It is decidedly different in the United States. Managers have long since noticed that to draw public patronage alleviations of the fatigues and discomforts of tiring journeys must be introduced in the operation of passenger trains. The percentage of disasters and deaths, though still large with us, is constantly on the decrease, and these features, with rapid transit, insure us from the competition of the world.

In Germany the passenger trains are made up of mixed coaches, that is, such as have subdivisions for first, second or third-class passengers. They are much smaller in length and lighter than the American coaches, and look a good deal like box cars in shape and size.

Each car has from five compartments up, seldom over eight or nine; each compartment is complete in itself, having no connection with those ahead or behind, and having on y a door, with movable glass top on each side, as a means of entrance and exit. These doors, by the way, have the handle on the outside, so that when once closed they are virtually locked, imprisoning, to a certain extent, those inside. The only way for a passenger to open the door would be to let down the glass side and reach out to the handle, which, however, is strictly forbidden on all German roads, and just as strictly enforced, too.

The conductor walks a gang plank on the outside of the car to collect tickets, after which he is supposed to enter a little watch-tower attached to one of the cars of his section—this has the appearance of a small dry goods box perched on the end and side of the coach, and makes a comical appearance. Passenger trains are under control of a head conductor, with several sub-conductors, all uniformed, the latter having each from two to three cars in charge.

As soon as a station is reached, each sub-conductor opens the depot side of all of his compartments, calls out the name of the station, and regulates as much as possible the disposition of new travelers in his coaches. These sub-conductors seem to be usually quite susceptible to bribes, which generally insures the traveler a whole compartment to himself and friends or family. In first-class compartments there is place for six persons; the seats are made of rich velvet or plush upholstery, and trimmings to a certain extent decorative and tasteful. The second-class has room for eight persons; the seats are also upholstered, but not so well finished. The third-class, which is the one mostly used by the people at large, has wooden seats and place for ten persons. The rate for this class of passage is from a cent to a cent and a half per mile, and for return passages much less, as a reduction of one third is generally made in such cases. Excursion rates are probably from one-half to three-quarters of a cent—hardly any more than the latter figure—which is cheap transportation sure enough.

There is yet a lower class—the fourth—operating, however, on only some of the roads. This class is intended for hucksters carrying truck to the cities, and is only local. The coach has no compartments, and what is strangest of all, no seats. The passengers are huddled together promiscuously, and find standing room as best they can!

One instance of the want of providing even the most necessary comforts is the total absence of drinking water or water-closets. No arrangement is ever made for the former. Where the latter has been attended to, a notice is posted in each compartment that a water-closet is provided for in one of the baggage cars; those desiring to use same must apply to the conductor, and at the next stopping place you are given the key, and naturally you must remain in there until the train reaches another station! This is probably one of the most absurd expedients that could have been hit upon.

Couplings are made in a very efficient manner, but altogether too slowly; you never hear of a detached car or broken sections.

Everything around the depots has a neat, clean and orderly appearance; all employés, except laborers, are uniformed, and as most of them are retired army officers and soldiers, their bearing is strictly military.

At all road crossings at grade-level, there is a watchman, who works the barriers on approach of trains. He is notified by telegraphic signals, works the barriers whether a wagon is there or not, presents arms, or rather safety flag, to the passing train, and then walks the track until the next train passes. They are provided with little houses immediately at the crossing and live there entirely. These little watch-houses are sprinkled all over the road every few miles apart.

The substantial manner in which the road-beds are originally constructed, does not require constant section and floating gangs of laborers, and the watchmen report the condition of track on their beat. Road repairs are therefore comparatively small on German roads. V. H. K.

* * *

STATE LINE MONUMENTS.

The lately surveyed line between the States of Pennsylvania and Ohio is being marked by stone monuments. They are about five feet long, leaving one foot visible above the ground, and are dressed to a point. On the east side the letter P is cut and on the west the letter O, while the north side records the number of miles distant from Lake Erie, and south the year of their erection. The new line, which, with these monuments, will be plain enough for anybody to distinguish, will prove of great value in settling disputes of property holders as to the State in which their taxes are due, and may also compel the changing of some roads which are either directly on the line or run back and forward over it.

* * *

SUBSIDY SECURED.—The track of the St. Louis, Jerseyville & Springfield Railroad reached the Mississippi River on the 31st, thus practically securing the subsidy of $100,000 and the right of way, provided the road reached the river in 1881.

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.

Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.

S. D. V. BURR.................ASSOCIATE EDITOR.

SATURDAY, JAN. 7, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States, Canada and the Sandwich Islands, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICE OF MEETINGS.

TELEGRAPH BROTHERHOOD.—A call has been issued for a convention of telegraphers, to be held in Pittsburgh on the first Monday in March next, "for the purpose of forming an international telegraphers' organization, having for its object the amalgamation of all existing telegraph organizations into one grand brotherhood." Each city, town and division of road is to be represented by one delegate, and an additional delegate will be allowed for every fifty operators employed.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The Twenty-ninth Annual Meeting will be held at 127 E. Twenty-third street, New York City, on the 18th inst., at 10 a. m.

OHIO SURVEYORS.—The third annual session will be held at Columbus, Ohio, on the 11th, 12th and 13th inst., in the Board of Trade Rooms, City Hall Building. Several subjects of great interest to surveyors will be discussed.

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THE YEAR WHICH HAS PASSED.

It is not unusual in enterprises such as ours to pause at intervals and consider how far the progress made is commensurate with the early hopes expressed, or with the efforts made, and also to take the public into the conference. So now, on the opening of the ninth year of our publication, we may be allowed to look back a short way, and, it may be, gather strength for new efforts in the consciousness of past success.

In the wide expanse of our country from ocean to ocean, occupied by a people overflowing with the spirit of adventure and enterprise, it was apparent that to the achievements of our engineers as a body, more than to any one class of operatives, we owed that material improvement which would prove the basis of our future as of our past success as a nation; and that a journal which aimed to chronicle from day to day the doings of this growing body of men was one that the spirit of the age called for. To meet this demand, so far as lay in his power, was the object of the proprietor of ENGINEERING NEWS, who aimed to make it what its name purported, engineering news pure and simple. But in the effort to do his *devoir* by his readers, he has been led to extend his labors to embrace, not only professional news, properly so called, but so much of technical instruction as he thought would be acceptable. To this end he has introduced, and will extend, as the encouragement to his labors may indicate its popularity, descriptions and illustrations of works either complete or in progress, or merely designed, which, although not "news" possibly to all his readers, yet must prove instructive to some of them, and to all serve as a record for future reference; and as an earnest of what he hopes to accomplish in this direction, it may not be amiss for him to point to what has been accomplished during a single year which has just closed, and while yet his purposes are in a measure undeveloped.

Taking the well known definition of the famous English engineer, Thos. Telford, as to what constitutes civil engineering, the proprietor of ENGINEERING NEWS has endeavored to cater to the wants of all who recognize their own professional status as embraced in that definition; and taken in the order of their duties comes the surveyor, the civil, the mechanical engineers, and then the contractor and builder; the combined labors of all resulting in a work of civil engineering.

Accurate surveys must be preliminary to any work of construction, and the proceedings of State conventions of surveyors; geodetic surveys; surveys of States; triangulations; the improvements in instruments; methods of laying out, providing for, and eliminating errors in, measurements; recording and preserving drawings; leveling, with improved methods of keeping field notes and hints for labor saving processes, and increased accuracy of results, have all received their share of attention in the volume just closed.

The formation of engineering societies as a potent means to advancement in science has kept pace with the increased calls upon the profession, and valuable papers upon all branches of construction will be found in their proceedings for the year, abstracts and copious notes from which form an interesting portion of our news, and are credited to the reports or proceedings of the various societies, as the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the Boston Society of Civil Engineers, the Civil Engineers' Club of Cleveland, Engineers' Club of Philadelphia, Engineers' Society of Western Pennsylvania, the Western Society of Engineers, the Michigan Association of Surveyors and Engineers, the Institution of Civil Engineers, the Liverpool Engineering Society and others, while the reports of city engineers furnish many valuable statistics. Much miscellaneous information, will also be found concerning the various principles and methods of practice, the materials in use, such as steel, iron, cement, timber, etc., etc., and tests for the same, with discussions on the merits of different plans, while details of their use in various constructions are interspersed throughout many papers, and appear but incidentally.

Of Engineering Structures the railroads take precedence in importance, and the accessories in use on them as suggested are largely represented, including rails, frogs, ballast, ties, earth-work, culverts, etc., and notices of important railroad works, either projected or in progress on this continent are given. Rapid transit in various cities, and comparisons between surface and elevated roads, underground railroads, ship railways, and the appliances of each and all, are largely noticed.

Bridges.—This item has become, since the introduction of steel as a material for bridge construction, a most important branch of engineering, and the competition between the large manufacturers has resulted not only in lessening their cost by reason of improved methods of dealing with the raw material, but in approximating toward the limit of economy in the structures themselves through a more scientific arrangement and adjustment of the parts. In fact, if any one subject more than another may be said to mark the present as the era of engineering enterprise, it will be found in the wonderful strides being taken in the plans and construction of great bridges and in the increased use of steel as a material. We refer (fully illustrated) to the great East River bridge and the details of formation and cable making; the Niagara suspension bridge, the Frith of Tay new bridge, the Forth bridge, the Pittsburgh suspension, the Albany bridge, the great Kentucky River bridge in detail, the Chaudière bridge details, the Ohio River bridge and designs generally of long-span iron bridges for railways, and notes of lesser structures and the various improvements in the application of metal work, and to reviews of books treating the subject of bridge building.

Tunnels.—Under rivers, such as the Hudson River Tunnel, with details of progress, proposed Dover, Arlberg, Simplon, St. Gothard, and kindred operations on less extended scale, such as tunnel railways in cities, etc., due mention has been made.

Canals.—Erie, Illinois and Michigan, Isthmus of Corinth proposed, Panama, with discussions and criticisms, the Welland and Lachine canals, notices of writings on the subject, and improved methods of movement thereon, Holland canals and dykes, canal works, public works of India drainage canals, dry and wet docks, have been considered as kindred in character of work, and bearing on inland navigation.

Improvements of Rivers and harbors by the U. S. Government, the Mississippi, as also the levee system, the jetty system, the calculation and utilization of river currents have been considered.

Electric and Gas Lighting, with their defects and benefits, a subject of growing importance in which our country is taking the lead.

Water Supply and Works.—The history and statistics embracing cost, method of operation and financial success, of one hundred and seventy of the water-works of the towns and cities of the United States, is a valuable series of papers, while the adjuncts of city water supply, such as pumping engines, pipes, and their flow, proposed methods of preventing waste, water meters, reservoirs, cost of mains, cost of water as power in this country, the impurities of various city supplies, artesian wells as a city supply, list of cities and towns supplied by artificial works in this country have been considered at length.

Sewering and Draining.—The growing attention to all matters bearing upon the public health will be found to have received its due notice. The various systems of sewering and their comparative advantages and applicability to different localities, have been enlarged upon, and will, in the future, be fully discussed; as without *health*, the costly improvements with which we surround ourselves will lose much of their value, and certainly a large share of the comfort to be anticipated from them.

Steam Engine.—Under this head will be found much matter of information, such as boilers, furnaces, and the many adjuncts to the steam engine and its varied modern applications, besides notices of valuable papers on the subject.

There are many other subjects relating to city improvement and matters of general interest to engineers which do not admit of classification, notice of which is omitted here, but which a glance at the index to this number will show have not been lost sight of, and will evidence the pains taken to furnish engineers with professional news.

Elementary articles have been avoided as much as possible, as the scope of the journal is avowedly *practical*, and the engineer does not look to a weekly publication for the A B C of his profession.

It will be seen by the above that our labors have been largely and necessarily eclectic in the interest of our readers. What of original matter is furnished by ourselves will be regarded but as the cement which binds the whole edifice together, for, however good this may be, no one thinks of constructing the entire building of it.

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ON PROBABLE ERROR.

BY MANSFIELD MERRIMAN, PROFESSOR OF CIVIL ENGINEERING IN LEHIGH UNIVERSITY.

When a quantity is measured several times with precision, the separate results will be found to disagree, owing to the impossibility of avoiding small errors of measurement. If the observations are made with equal care, or have, as we say, equal weight, there is no reason why one of them should be preferred to the other, and their average or arithmetical mean will furnish the most probable value of the quantity as shown by the measurements. The words "most probable value" are used to mean that value which the mind regards as most reliable, or as nearest to the true value, or it is the value in which one has the greatest degree of confidence, and upon which one would prefer to wager money if it were a question of wagers. For example, suppose the length of a certain table is to be determined; one measurement gives 4.328 meters and another gives 4.322 meters, and if they are of equal reliability or weight the most probable value must be half way between them, namely, 4.325 meters, or their arithmetical mean. If a third measurement be made giving 4.331 meters, the arithmetical mean of the three becomes 4.327 meters, which is now the most probable value instead of 4.325. Whatever be the probability or degree of confidence placed in 4.325 that placed in 4.327 should be higher, for the expenditure of time, care and money required to deduce the latter is greater by one-half than that required to deduce the former, and thus in general the probability attached to any result, which is the mean of several observations of equal weight, increases with the number of measurements. The greater the number of measurements the higher is the probability of the mean; that is to say, the greater is our degree of mental confidence that it nearly approaches the true value of the quantity sought.

The degree of probability to be ascribed to a mean of several observations also varies with the care and precision taken in doing the work. This will be shown by the agreement between the results of the individual measurements. For instance, let an observer measure an angle five times with a theodolite reading to five seconds, and again with a transit reading only to minutes. Suppose the result to be the following :

By the theodolite.			By the transit.		
46°	28'	25"	46°	28'	00"
46	28	20	46	29	00
46	28	25	46	28	00
46	28	30	46	28	30
46	28	25	46	28	00
Mean = 46	28	25	Mean = 46	28	18

Here the mean 46° 28' 25" is the most probable value for the theodolite observations, and the mean 46° 28' 18" is the most probable value for the transit observations, but every one will recognize that the reliability of the latter is much less than that of the former. The individual readings of the theodolite differ from the mean only 5" at the highest and between themselves 10" at the highest, while those of the transit differ from the mean as high as 42" and between themselves as high as 60". These differences alone, if we knew nothing about the precision of the two instruments, would tell us that the reliability of the first set of observations is far greater than that of the second.

The probable error is a quantity which shows the degree of probability or reliability of an observed quantity as deduced from the agreement of the measurements among themselves. An *error* is deviation from the truth. The *probable error* is an error of such a magnitude that the chance or probability of the observed quantity being less than that amount from the truth is equal to the chance or probability of being more than that amount from the truth. For instance, it can be shown that the probable error of the mean of the above theodolite observations is one second, and it is an even wager that 46° 28' 25" lies within 1" of the true value of the angle or that it does not. And in such a case it is usual to write the probable error after the mean with the ± sign between them, thus

Theodolite mean = 46° 28' 25" ± 1".

It may also be shown that the probable error of the mean of the above transit observations is eight seconds, and we write

Transit mean = 46° 28' 18" ± 8".

It will hence be seen that the amount of the probable error indicates the degree of reliability to be placed in the mean. The less the probable error, the greater is the precision of the observations and the confidence we can place in the mean. Thus we could afford to make an even wager that the theodolite mean lies within 1" of the truth, while for the transit mean we could only lay the same wager that it lies within 8" of the truth: our confidence in the theodolite mean is then, we may say, eight times as great as in the transit mean, or its degree of precision is eight times as much.

The deduction of the rules for computing probable error may be found in books on the Method of Least Squares. The following is the rule for the most common case, namely, for that of the mean of several measurements of equal weight made upon a single quantity :

1st. Add together the several measurements and divide by the number of measurements, thus obtaining the arithmetical mean or most probable value.

2d. Subtract each measurement from the mean and thus obtain the differences, about half of which will be positive and the other half negative.

3d. Square each of these differences and take the sum of the squares.

4th. Divide the sum of these squares by the number of observations and this quotient by the number of observations less one, and take the square root of the result.

5th. Multiply this by the decimal 0.6745 and the product will be the probable error of the mean.

In the shape of a formula this rule may be more simply stated. Let N be the number of observations, D one of the differences obtained by subtracting a measurement from the mean, and SD^2 the sum of the squares of all these differences, then

$$\text{Probable error of mean} = 0.6745\sqrt{\frac{SD^2}{n\,(n-1)}}$$

The following example will show the application of the method. The distance between the two fixed points was measured seven times with a tape line and the values found as given in the first column of the following table. Required the mean and its probable error.

Feet.	D	D^2
399.05	+0.10	0.0100
399.19	−0.04	0.0016
399.17	−0.02	0.0004
399.23	−0.08	0.0064
399.13	+0.02	0.0004
399.03	+0.12	0.0144
399.25	−0.10	0.0100
mean = 399.15		SD^2 = 0.0432

The sum of the seven measurements divided by seven gives 399.15 for the mean. In the second column, headed D, are given the difference between the mean and the measurements, and the third column gives the squares of these differences. The sum of these squares is 0.0432. This divided by 7 and then by 6 gives 0.00103, whose square root is 0.0321. The product of this by the abstract decimal 0.6745 is 0.022, which is the probable error of the mean. We may then write as the final result:

mean = 399.15 ± 0.022 feet.

It is then an even chance that the true length of the line lies between the true limits

399.15 + 0.022 and 399.15 — 0.022

that is between 399.172 feet and 399.128 feet, or that it lies outside of those limits

It should be carefully noted that the mean and its probable error to be reliable must be deduced, not only from precise measurements, but from measurements where every care has been taken to exclude errors of a constant nature. If, for instance, the tape line in the above example is too long or too short that error will appear also in the mean. Mathematical theory of probability, in short, from which the method of probable errors is deduced, deals only with accidental errors of observation, namely those that are unknown and supposed to be governed by no laws but those of chance.

The theory of errors teaches that all observations are approximate, that we never can determine the exact numerical measure of a quantity, and that the best that we can do is to find a result more or less probable to be used instead of the true value, for the case discussed in this article the method of least squares shows that the arithmetical mean gives the most probable value. But it is not sufficient for those who are to use this mean that it be merely given without any statement of its degree of reliability. For all precise observations the probable error should be stated that a clear mental idea may be formed of the probability and reliability of the mean, and that it may be properly used in connection with other results of the same kind.

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THE IRON TRADE.

[Prepared specially for Engineering News.]

Reports from all the leading iron and steel producing and market centers at home and abroad confirm the statements heretofore made in these columns as to the remarkable activity in the making of iron and its multiform products. From private correspondence had with most of the large manufacturing firms, especially of construction iron and iron used in heavy engineering work, it appears that there is a greater volume of work projected, contemplated and uncompleted than ever before. The leading item following railway construction is bridge building. Manufacturers of structural iron have, in a general way, orders sufficient to carry them at full capacity over the winter and into April. The work in hand is for distribution all over the country. Since December 1 there has been a gradual accumulation of inquiries and orders, many of which come from railway companies in the Southern States. Recent reorganizations and changes of management have infused new life into railway construction, and bridge works are feeling the benefits in orders, which at present rate of progress promise to overcrowd productive capacities early in the present year. In anticipation of an extraordinary demand considerable capacity is being added. The projected construction of not less than 20,000 miles in the United States and Mexico, not including fresh enterprises constantly coming into notice, will require all the iron which our mills can produce, and probably more. A second factor not to be overlooked in estimating the probable course of construction iron next year is the enormous amount of house-building, large storehouses, manufactories, depots, etc. The question for manufacturing interests to consider is the present and prospective capacity to make iron sufficient to meet the probable requirements. That they will exceed the requirements of last year by 30 per cent. is not questioned by those who know. No mills were idle in 1881, but single turn prevailed and output was restricted during the first half of the year to suit demand.

The merchant bar mills were caught napping, so to speak. The same fate may possibly be in store for the manufacturers of structural iron and plate and tank, wrought and cast pipes and tubes. A fan-like tail of improvements is following the building of railroads. Towns are springing up, older towns and cities are expanding in growth and wealth, and engineering works are being propelled with a corresponding vigor. The columns of our class journals exhibit to some extent the degree of enterprise let loose. Manufacturers of finished and crude iron are now on the *qui vive* lest their failure to forecast events should precipitate enormous supplies of foreign iron and depress the market. It is time that violent fluctuations in the iron trade were terminated. It is not easy to make too much of such an article in this decade. Spurts of activity have followed seasons of extreme depression. Prices have sunk to bankruptcy limits, and then leaped to limits which barred enterprise and repressed activity. The excuse in the past has been uncertain tariffs and the dread of importations. Contemplated legislation on the one hand, and great industrial activity abroad on the other, are acting to remove these causes.

Engineering enterprises of unprecedented magnitude are looming up.

Steady iron markets and moderate prices are essential to the prosecution of enterprises, great or small. The inflation of values between 1862–1873 helped to terminate that era of activity. That error is not being committed. Prices are kept within moderate limits, but an advance which would dissuade capital and enterprises is no more impossible now than then. There are no causes for apprehension as to the future. American enterprise has demonstrated its ability to deal in a masterly manner with all issues, problems and difficulties. No doubt the possible dangers hinted at are seen by some, and preparations are being made for their circumvention. An enhancement of prices attracts less skillful management into business to increase the force of competition in seasons of moderate activity.

Blast furnaces have in general about two months product sold, and prices are at a point which is leading to negotiations with foreign holders. Merchant iron makers are well sold up and are taking all orders presented subject to market changes. Orders for railway material are constantly going abroad because of the difficulty of obtaining deliveries. Nearly all blast furnaces are in blast that can run. New mills are going up and additions are being made to old ones. The iron trade enters on 1882 under better auspices than was ever before its good fortune to have.

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PERSONAL.

MR. SELAH CHAMBERLAIN, a Cleveland contractor, has just been paid $200,000 in cash and $2,000,000 in new 4½ per cent. bonds, by the State of Minnesota, the conclusion of a legal fight of nearly twenty-five years' duration. Mr. Chamberlain brought away his magnificent fortune in a special car, which was well guarded from St. Paul to Cleveland. The American Express Company charged $3,500 for transportation to Cleveland, which Mr. Chamberlain thought was exorbitant, so he took his own method and risk.

DR. JOHN W. DRAPER, the eminent scientist, died at his home at Hastings-on-the-Hudson on the 4th. He was born at St. Helens, near Liverpool, England, May 5, 1811.

COLONEL W. C. MELVIN, Civil Engineer in charge of the government works at the mouth of Tone's Bayou, Red River, died suddenly at Shreveport, La., on the 3d, it is supposed of heart disease.

CONRAD HERBERT, superintendent of the La Fayette (Ind.) water-works, has resigned.

MR. ROSWELL SMITH, publisher of *The Century*, has just performed a generous act, rare indeed in the annals of business. He not only gave $5,000 in Christmas gifts to those whom he employs, but distributed among the leading members of his literary and business staff $16,000 in *Century* stock, a stock which, as has already been stated, is exceedingly valuable.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 520, Vol. VIII.)

CLXX.—BRIDGETON.

Bridgeton, New Jersey, in lat. 39° 31' N., long 75° W., is on both sides of Cohansey Creek, 37 miles south of Philadelphia, in a gently undulating region. The town was settled in 1731, incorporated as a borough in 1858 and as a city in 1865.

Water-works were built by the city in 1877, after the plans and under the superintendence of Isaac S. Cassin, C.E., taking the supply from East Lake, a natural pond of 80 acres area within the city limits, the ordinary flow of which affords a valuable water power. The overflow from the lake is impounded in a retaining reservoir holding 3,000,000 gallons, and is pumped thence by a compound duplex Worthington pump of 1,000,000 gallons capacity, through 2,300 ft. of 16 in. cast-iron pipe, into a reservoir built in excavation and embankment on a hill 103 ft. above the Cohansey, 88 ft. above the lower reservoir and a mile from the city. The reservoir is 135 ft. square, 15 ft. deep, and is in two divisions. Distribution is by cast-iron pipe, of which 10.63 miles of from 16 to 2-in. diameter, 3 miles being less than 6 in. diameter, were in use in December, 1880, with 72 fire hydrants and 392 taps and 2 meters. Galvanized iron service pipes are used. A 16 in. submerged pipe crosses the river. The population in 1880 was 8,722 and the daily consumption 108,208 gallons.

The works have cost $79,070.50 and the bonded debt is $76,500, bearing 6 per cent interest.

The city pays to the water fund $38 per year for

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each fire hydrant. This amount is included in the receipts in the following statement:

	Expenditures.			Receipts.
	Construction.	Interest.	Maintenance.	
1878	$7,931.12	$3,440.04	$1,209.17	$1,016.45
1879	5,294.08	4,117.17	1,398.53	5,508.70
1880	2,832.40	4,140.00	1,494.81	6,831.80

The superintendent of the water-works, Timothy Woodruff, reports to the water committee of the Common Council.

CLXXI.—ROCKFORD.

Rockford, Illinois, in lat. 40° 18 N., long. 89° 10 W., is on both sides of Rock River, which at this point is crossed by a dam 6 ft. high furnishing a water power used for manufacturing.

Settled in 1834 it was incorporated as a city in 1852. Water-works were built by the city in 18.5 after plans furnished by the Holly Manufacturing Co., taking water from the river and pumping it directly into the main by Holly engine and four double-acting piston pumps of 9 in. diameter and 24-in. stroke. In the inlet pipe from the river there is a filter 25 ft. in diameter, filled with sand and charcoal, which passes 800,000 gallons of water per day, but does not work satisfactorily. A well 50 ft. in diameter and 45 ft. deep was also sunk in water-bearing gravel, which is said to be capable of yielding 1,500,000 gallons per day. Distribution is by cast-iron pipe of which 27 miles are in use, of from 20 in. to 2-in. diameter, with 190 fire hydrants and 1,000 taps. Wrought-iron pipe and lead pipe are used for service pipe. The mains on the opposite sides of the river are connected by 680 ft. of submerged 12-in. pipe, with 13 flexible joints

The population in 1880 was 13,136, and the daily consumption 900,000 gallons. The ordinary pressure maintained is 57½ lbs. and the fire pressure from 95 to 110 lbs.

The cost of the works has been $280,070.44. The expenditures in 1880 were $5,791.76 and the receipts $7,273.78.

The works have been managed since their construction by S. P. Crawford, Chairman of the Water Committee of the Common Council. John A. Ferguson is the Chief Engineer.

CLXXII.—NEWPORT, R. I.

Newport, Rhode Island, in lat. 41° 29′ N., long. 71° 19′ W., on Narragansett Bay, is on the summit and slopes of a hill on the south part of the island of Rhode Island.

Settled in 1639, it was incorporated as a city in 1784. Water-works were built in 1875 by George H. Norman, and were owned by him alone until June, 1881, when a company was organized. Water is taken from Easton's Pond, formed by impounding the water of 4½ sq. miles watershed, by two dams of sand, one 2,800 ft. long, 15 ft. high and 12 ft. wide at top, with the water-slope covered with rip-rap stone; the other 2,000 ft. long, 4 ft. high and 6 ft. wide on top. The area of the pond is 160 acres. From the pond the water is lifted 160 ft. into a reservoir of 10,000,000 gallons capacity, built in excavation and embankment, with its flow-line 60 ft. above the highest point in the city. There are two steam pumps, a "Knowles" of 19½-in. water cylinder and 36-in. stroke, and a "Carr-Selden" of 12-in. water cylinder and 24-in. stroke.

Distribution is by cast-iron pipe and some wrought-iron and cement pipe. About 30 miles are in use of from 18-in. to 4-in. diameter, with 157 fire hydrants, 113 gates, 1,160 taps and 27 meters. The city pays for the use of water for fire hydrants. The service pipes are of wrought iron, cement lined. The population in 1880 was 15,693. The daily consumption in 1881 was about 500,000 gallons. The capital stock of the company is $500,000. Statistics of cost and revenue are not furnished. Charles B. Weaver is the superintendent and treasurer, and G. Cole Stevens the clerk.

CLXXIII.—NORRISTOWN.

Norristown, Pennsylvania, in lat. 40° 7′ N., long. 75° 15′ W., is on the Schuylkill River, 16 miles above Philadelphia. The topography is hilly. Settled in 1778, it was incorporated as a borough in 1812.

Water-works were built by a private company in 1847, after the plans of William E. Morris, C. E., taking the supply from the river, which opposite the town is divided by an island a mile long, and from the further channel a conduit 20-in. diameter and 1,450 ft. long conveys the water to the pumping station, where it is lifted by three steam pumps, one of 7¾ in. bore and 60-in. stroke, a double-acting piston pump, one a Worthington duplex pump, of 1,000,000 gallons capacity, and the third a double-acting piston pump, of 16-in bore and 16-in. stroke, built by R. S. Newbold & Son, into two reservoirs, one 194 ft. above the river, and of 10,000,000 gallons capacity, the other 183 ft. above the river, and of 750,000 gallons capacity. Both are in excavation and embankment, in two divisions, and with the inner slopes lined with brick pavement on clay puddle.

Distribution is by cast-iron pipe of 16 in. to 3-in. diameter. The pumping main is 1⅛ miles long, of 24-in. diameter; 27 miles of pipe are in use, with 85 fire hydrants, 125 gates and 2,500 taps. The town does not pay for use of hydrants. The population in 1880 was 13,063 and the daily consumption 800,000 gallons. The capital stock of the company is $150,000. The works have cost $275,000. The bonded debt is $90,000, at 5 per cent. interest. H. S. Seehler is Secretary of the company and John Slingluff the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From Timothy Woodruff, Superintendent, reports of Bridgeton (N. J.) water-works for 1878, '79, '80. From the Water Commissioners, report of Erie (Pa.) water-works from May 1, 1879, to Dec. 31, 1880. From Geo. P. Wescott, Superintendent, history of the Portland (Me.) Water Company. From John A. Ferguson, Chief Engineer, statistics of Rockford (Ill.) water-works. From John Slingluff, Superintendent, statistics and water rates of Norristown (Pa.) water-works. From G. Cole Stevens, Clerk, statistics of Newport (R. I.) water-works.

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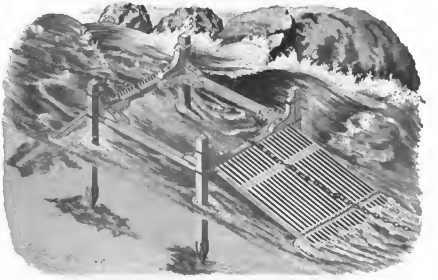
SYLVESTER'S TIDE AND CURRENT BREAKERS.

The attention of our readers is called to the above engraving which represents a tide and current breaker that has been used during the past six months in the channel of the Piscataqua River, Portsmouth, N. H., for retarding the current while removing rock.



SYLVESTER'S TIDE AND CURRENT BREAKER.

The velocity of the current in this river at this locality, whether at ebb or flood tide, is from four to six miles per hour, and the time of slack tide is so brief that it became a doubt whether the ledge known as Gangway Rock, which was in the channel and covered with twenty-two feet of water at high tide, could ever be removed.

The work is now being successfully done by the use of "Sylvester's Tide and Current Breakers," which retard the current to such extent as to make comparatively still water under the lee of the breakers, and a submarine diver is enabled to perform in safety any required work at all times.

The tide and current breakers, or the direct agent that retards the current, consists of a series of timbers that rise and fall at each end of the frame, according to the direction of the current. These timbers are uniformly spaced so that a sufficient quantity of water may pass through them, and the water that has been rendered turbid by the disturbance of the soft material on the bed of the channel is made perfectly clear.

In whatever direction the currents may be, the breakers on the end from which the current is running will be forced down until they rest on the bed of the channel, and the breakers on the opposite end will float on the surface of the water, as seen in the engraving.

In currents of very swift velocity the frame with the breakers may be anchored, though under ordinary circumstances this is not necessary, as its weight keeps it in position.

Our readers will see the utility of this invention in any swift current where work without it would be impossible; not only for removing rock, but for building and repairing dams, removing obstructions and other work where the hours of labor are limited by the current or changes of the tide.

This invention was patented August 23, 1881, and parties wishing particulars in regard to any of its details, or general information, may address Isaac A. Sylvester, Newton Centre, Mass.

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SAND FILTRATION AT BERLIN.

BY PROF. WILLIAM RIPLEY NICHOLS.

(From the Journal of the Franklin Institute.)

Up to the present time there has been very little done in this country in the way of systematic filtration of water supplies, partly, perhaps, from indifference and lack of information, but mainly on account of the expense. The numerous complaints which arise in the case of almost every city and town supplied with surface water render the question of filtration an important one for the immediate future, and any engineer who has to do with the planning of water-works is liable to be called upon to estimate the cost of filtration and to state how far it may be expected to overcome anticipated or existing evils. For this reason, details of the practice in well-managed works, where the conditions are similar to those which obtain with us, are of peculiar interest. Such details are given in a pamphlet recently published by the superintending engineer (Betriebs-Ingenieur) of the Berlin filtration works. The pamphlet also contains the results of observations on "natural filtration" in the neighborhood and elsewhere.

A very considerable portion of the city of Berlin is still supplied with water from the dirty and sluggish Spree after it has been subjected to a very thorough filtration. The water is taken from the river directly on to the filter-beds, and although the sluggishness of the flow would allow the deposition of much suspended matter, the very considerable water traffic between Berlin and Köpenik, past the water-works, keeps the water in a roily condition. Furthermore, the Spree receives, above the point from which the supply is taken, the waste-water of a number of factories, among which are dye and print-works, it also receives the effluent of a sewage farm, mixed, in some cases, with sewage itself. Besides being thus contaminated, the water, especially in time of flood, possesses a deep brownish-yellow color and, at times, a peculiar *pondy* taste, due to vegetable extractive matter. Moreover, from spring until fall, a more or less copious growth of *algæ* adds to the disagreeable character of the water.

The filtration works now supply daily about 40,000 cubic meters (in round numbers 10½ million U. S. gallons) of filtered water—in summer often a larger quantity. There are eleven filter-beds—three covered and eight uncovered—having a total area of 37,000 square meters (about 400,000 square feet). The beds are constructed on the English model, fine sand at the top and coarser material below. With the large area at disposal it is possible to carry on the filtration at a very slow rate. The water is used, of course, in varying quantities from hour to hour, and, on account of the small size of the clear water reservoir, a constant rate of filtration is impossible; the maximum rate is, however, not over 4 inches downward per hour.

For the greater part of the time 10 square feet of sand surface is not required to furnish much more than 35 cubic feet of water in twenty-four hours. This would be at the rate of only 24½ U. S. gallons per square foot, and very much less than is the practice elsewhere. The filtration takes place under a very slight head, seldom of more than 20 inches, but even with this low pressure and slow delivery it has been found impossible, with clean sand alone, to filter the water satisfactorily. If the unfiltered water be allowed to stand a fortnight or so, although the larger of the suspended particles will have settled to the bottom, the water still retains a milky appearance, and sand alone cannot remove the exceedingly fine particles to which this appearance is due. On this account, the water from a freshly cleaned filter is not used at once, but is allowed to stand on the bed and then passed through very slowly until a thin coating has formed on the surface of the sand. This coating is essential to the removal of the finest particles from the water subsequently filtered. Of course, as the coating becomes thicker the filtration becomes more difficult, until it partially stops and the filter is "dead."

As has been hinted above, the great trouble in summer is from the abundance of small *algæ*, which soon clog the filter. When the *algæ* are absent, 10 square feet of surface usually filters 700 cubic feet before cleaning is necessary, but in summer the capacity is not over 350 cubic feet to the same area. Sometimes the meteorological conditions are such, especially late in the season, that the *algæ* enter into decay and form a peculiarly slimy and almost impervious coating over the surface of the sand, so that it becomes impossible, under the pressure commonly employed, to pass more than 70 cubic feet of water through 10 square feet of sand surface. This decomposition of the *algæ*, as described by Piefke, has often been noticed in the ponds and reservoirs of the Eastern and Middle States, and the very particular observations which Piefke gives on this point are well worth the attention of any who are called upon to consider the question of filtration in this country. We may note the fact that under the conditions just referred to, the superiority of the covered beds became very evident. As has been observed in this country, the decay of *algæ* increased very much the amount of ammonia (of "albuminoid ammonia") and of nitrites and nitrates. A rather curious observation was made in the decomposition of the *algæ* on the open filter-beds. The gaseous products of decay collected in bubbles until these were sufficiently large to break through the slimy coating and rise to the surface. In the hot days of August this evolution of gas was very considerable, and, as a result of this piercing of the coating, a "dead" filter was sometimes brought again into activity; when such a filter was cleaned the little cavities in the sand thus produced were clearly defined, filled, of course, with accumulated dirt.

The *algæ* are not to be regarded as an unmitigated evil. Besides making the removal of the finer portions of the sediment possible, in their growth they are purifying agents; they change at least a part of the dissolved organic matter into insoluble substances which settle to the bottom and can be removed by filtration. It is, however, desirable that the water should not remain in contact with them aftey have begun to decay.

If, after filtration, the apparently perfectly clear Spree water is allowed to stand for eight or ten days green *algæ* develop themselves, which is probably due to the fact that the spores of the plants are not retained by the filters. This fact, however, is of no practical consequence in the case of the Spree water, for the water is consumed long before the spores have had time to develop. This is not the case with all waters, as has been found by experience in the works which supply another portion of Berlin. The "ground water" of the Tegel supply contains an *alga*, the *crenothrix polyspora*, of such rapid development that filtration would not be of much use, as the unremoved spores would develop in the service pipes before the water was consumed.

As has been mentioned, the Spree water often possesses to a marked degree the brownish-yellow color common to streams which flow through marshy or peaty regions and to the water of most impounding reservoirs. This color, with the taste which at times accompanies it, gives rise to general complaint, but even very slow filtration fails to remove it to any considerable extent. Filters of finely-prepared cellulose remove a large proportion of the color, but are hardly practicable on the large scale. If sand filters have a slight action in this direction, it is to be ascribed rather to the sediment containing vegetable fiber than to the sand itself.

A few pratical details of management may be of interest. In the Berlin beds the thickness of the sand is 600 millimeters (about 2 ft.). At each cleaning the sand is removed for a depth of about 10 millimeters, but fresh sand is not returned to the bed until only about 200 millimeters of the original thickness remain. The foul sand is allowed to stand exposed to the air until, by decay, the organic matter has lost its slimy character; it is then washed and eventually replaced upon the beds. When the filters are emptied the water is drawn completely off, and by successive and systematic stirring nearly the entire thickness of the sand is exposed to the air in order that the small amount of organic matter which was not retained at the surface may be oxidized and destroyed. With the same object in view, the air is allowed to circulate freely, for several days if possible, through the coarser underlying material. The filters are filled from below with filtered water, and then the water is passed through slowly and is allowed to waste for several days.

Artificial filtration is, on the whole, not a difficult operation, but it is one in which the details must be conscientiously and intelligently attended to, and there is no room for negligence or false economy. That the beds must be often cleaned, that from time to time a few thousand cubic meters of filtered water must be used in refining the beds; these are matters of no consequence if it is thereby possible to reach the main object in view—namely, the furnishing of a good water. The place for economy is in the choice of the cheapest way of carrying on the various details of the works.

Piefke also describes experiments on the use of iron as a purifying medium as a preliminary to sand filtration, but the experiments did not awaken hopes that iron could be used advantageously on the large scale.

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AMERICAN SOCIETY CIVIL ENGINEERS.

At the regular meeting of the Society, held on Wednesday evening, the 4th inst., the following were elected:

FOR MEMBERS:

Onward Bates, Civil Engineer, Dardenne, Mo.

William Wingfield Bonnyn, Civil Engineer, Montreal, Canada.

Samuel M. Felton, Jr., Gen. Supt. Pittsburgh, Cincinnati & St. Louis R. R., Columbus, O.

Charles E. Greene, Chief Engineer Extension Toledo & Ann Arbor Railroad, Professor of Civil Engineering University of Michigan, Ann Arbor, Mich.

Thomas W. Jaycox, City Engineer, Leadville, Colo.

Mirtiliano Sicard, Civil Engineer, Ibagué, U. S. of Colombia.

FOR ASSOCIATE:

George Henry Frost, Civil Engineer, Engineering News, New York City, N. Y.

FOR JUNIORS:

James Peter Bogart, Engineer Connecticut Shell Fish Commission, New Haven, Conn.

Arthur Haviland, Assistant Engineer Tehuantepec Inter-Ocean Railroad, Jaltipan, Mexico.

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POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

The regular weekly meeting of the Polytechnic Association, a branch of the American Institute, was held Thursday evening, Dec. 15, the President, Mr. Stetson, in the chair.

Mr. Keith read the rules lately put in force by the Board of Underwriters of New York City in regard to the manner of putting in electric light apparatus to buildings in this city to avoid danger from fire. The rules go to an extreme of caution. Mr. Keith explained that the electric light companies already largely exceed the required conductivity, 50 per cent. excess. The smallest, even with the arc system, is No. 8 wire. It conducts the current without being appreciably raised in temperature. Heat is generated in a conductor when it is too small to carry the current freely. No. 16 is large enough. It will only raise the temperature to about 110 degs. Fah. With the incandescent system most companies use larger wire, up to No. 3. These wires are a fourth of a square inch in section. The electric resistance of a small wire absorbs and wastes power which otherwise would show itself as light at the lamps.

The case was analogous to passing water through pipes. A small pipe requires more head or force to cause the passage of a given quantity of steam, or any fluid, in a given time, and the working pressure at the delivery end is reduced by the wire-drawing.

Mr. Keith averred that the brick, or plaster walls and ceilings of a building are as good insulators as any insulating substance which can be put around the wires. Dry wood is nearly or quite as good. He thought there was no advantage worth considering in an insulating covering for wires on the ceilings; but such was important in places upon the floors or walls where there is a liability of some conducting substance touching both the inlet and the outlet wires.

Where the positive and negative wires run near together they should be well covered by some non-conducting substance, which will absolutely prevent accidental contact with both at one time. The rules were sound on that.

There is not a particle of danger in touching one wire with any substance at any place. All thought the practice of returning the current by the earth, or by connections to water or gas pipes, should be absolutely prohibited. Doing so makes all conducting substances in connection with the earth a return conductor.

Mr. John W. Sutton opened the regular subject, measuring power. There were two general systems. One extinguished the power it measured by friction induced for the purpose, and could only be used a short time as a test. The other measured without much retarding, and could in theory be used all the time.

The horse-power of engineers' parlance is a little more than an average horse can do steadily ten hours a day. It is thirty-three thousand foot-pounds per minute. It is 550 pounds lifted one foot high each second.

The De Prony brake, familiarly known as the "pony," was drawn on the blackboard and explained with a modification employed by the American Institute. A lever is clamped upon the shaft or upon a smooth pulley thereon with just sufficient force, and the weight of the lever and of anything hung thereon which is lifted by the friction gives the resistance. This must be multiplied by the speed, making due allowance for the leverage to get the equivalent of the number of pounds per minute lifted one foot high.

On the transmission system, Mr. Sutton's favorite dynamometer was a pulley connected to the shaft by springs, with delicate devices for observing while running exactly how far the springs were deflected to know the strain in pounds, which being multiplied by the velocity in feet per minute, gives the number of foot-pounds per minute.

For a crude measurement a belt just able to do the required work without slipping could, with cheap apparatus, be made a test of power. Find by repeated trials just how much strain on a lever of a given length will slip the belt when the machinery is stopped, and we have the strain under which the belt is acting while in use, which, multiplied into the speed, gives the power.

Mr. N. S. Keith described and drew the Kent dynamometer, a Pittsburgh invention, used at the Stevens Institute, at Hoboken. The power is communicated from one gear-wheel to another through a loose gear-wheel, which of course tends to move bodily with twice the force communicated. This tendency to move is measured very accurately by mounting it on a weighted lever, hung pendulum fashion; the sine of the angle of inclination assumed, gives the equivalent of a horizontal lever supporting an equal weight.

The machine at the Hoboken Institute was very well made by the students themselves as a part of their education. The driving shaft was in line with the driver, each having a similar bevel-wheel, face to face, a sufficient distance apart to allow the pendulum lever and the bevel-wheel thereon to work between them. To reduce the strain on the central point of the pendulum there were two bevel gear-wheels on that lever, one on each side of the center. Both served to communicate the dynamic effect from one shaft to the other, and both contributed to deflect the heavy pendulum so as to measure exactly the strain communicated.

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PREVENTING THE BURSTING OF WATER PIPES THROUGH FROST.

In a short paper recently read before the Physical Society in London, a method patented by Powell, Rigby & Co. was referred to, by which the bursting of water pipes by frost may be prevented. The proposal is to use pipes of an elliptical or other than round section. As the sectional area of an elliptical pipe is less than that of a round pipe of equal perimeter, it is obvious that when the inclosed water freezes and expands the section of an elliptical pipe will more nearly approach a circle. There is more, however, in the idea than at first sight appears.

When the water in a round pipe freezes, and the pipe begins to stretch at any point, it becomes both larger in diameter and thinner there than elsewhere; each of these effects causes the pipe to be still weaker at the place effected; therefore, a round pipe is in a state of unstable equilibrium. With elliptical piping the case is different. The force required to alter the shape of an elliptical pipe increases as its section changes from the elliptical towards the circular; therefore the effect produced by a change of shape at any place makes that place stronger. An elliptical pipe is, therefore, in a state of stable equilibrium, and will change its form uniformly from end to end. This fact is of great importance, as if a portion only of a pipe is exposed to the cold the whole is effective, and it will require a proportionately greater number of frosts to make the pipe round. An inspection of the pipes every two or three years will give absolute security, for as soon as they show signs of becoming round they can be squeezed back again to their original section. Experiments have confirmed in every detail these theoretical deductions.—*Com.*

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LITERATURE.

Steam Heating for Buildings, or Hints to Steam Fitters. By WM. J. BALDWIN, Engineer. Illustrated. John Wiley & Sons, New York, 1881.

This is essentially a practical work on the gravity system of steam heating, as applied to all purposes, including cooking, washing and drying, with such reference to standard writers on the theoretical principles involved as are essential to the establishment of rules for practice, embracing all the details of the workshop and the fitting up, sufficiently illustrated as to enable the workman to design, lay out and complete, ready for operation, a steam-heating apparatus for any of the purposes for which steam heating is applied, and is so well written that we can only suppose the following to be accidental. He likens "the boiler to the heart: the steam pipes the veins, and the return pipes to the arteries; thus carrying heat and life into every part of a building." This, we think, is a little mixed: but it is not as a work upon anatomy that we recommend the book, but for its clear, practical elucidation of a subject, the literature of which has, up to this date, rather scant proportions.

Manual of Logarithmic Computations. By ALFRED G. COMPTON, A. M. John Wiley & Sons, New York, 1881.

If the simplicity of calculation by means of logarithms were taught at the time, or thereabouts, when we learned the multiplication table, it would be proved in after life a great saving of time and patience. If one is engaged in logarithmic computations daily, or so frequently that the practical operations of calculation become, as it were, intuitive, a book like this would not become a necessity, as the process of computation by logarithms is usually sufficiently explained for practical purposes in the introduction to all published tables of any respectability. But if references to such tables are made only at long intervals, as is the case with many persons, the uncertainty that accuracy has been secured by following the simple practical directions, not infrequently leaves a doubt upon the mind of such as have not been thoroughly trained in elementary mathematics, for the clearing up of which ready means may not be at hand, and it is this class of computors who are particularly indebted to such tables for shortening computations, and to whom we would recommend this little work, as containing the clearest and most concise explanations of any intricacy which may arise in such methods of computation with which we are acquainted, and it deserves a place as a text-book in every school—for, as above hinted at, the principles and uses of recognized methods of abridging lengthened computations cannot be taught too early in this practical age.

We are induced to call attention to this from the fact of having received lately for publication an extended paper from a professor of civil engineering in a Western university, not only impugning the generally received fact of logarithmic computations being shorter and simpler, than such as are more direct, but calling in question their accuracy as well! While Professor Compton does not refer directly to the possibility of such attacks, he yet incidentally meets the objections by explaining very concisely the process through which any degree of accuracy may be attained by their use, and the determination of the limit of error involved in any case, and which the computor can, at his option, modify to any desirable extent.

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AMENITIES OF NEW YORK JOURNALISM.

The New York *World* excites itself quite needlessly over the question of its nominal ownership. We know of nobody who is specially interested in finding a tangible person or corporation behind that changeable entity known as the *World*, unless it be two paper manufacturing firms, who have found some difficulty in making due service of legal process instituted to recover unpaid debts. If the person who claims to have been President since 1876 of an alleged corporation owning the *World* will publish his name, address, and office hours, it might save time and shoe-leather to the lawyers' clerks and subpœna servers, but would hardly be an item of general interest. The *World's* gibberish about stock-jobbing advertisements may indicate the very modest value which it places upon the use of its own columns for such purposes, but is hopelessly irrelevant to the statements made in *The Times*. We think the *World* would have some difficulty in finding a stock-jobbing or other speculative person verdant enough to pay five hundred cents for the publication of sufficient proof that the *World* and its proprietor or director are equally destitute of character and principle. We have told the story of the Manhattan swindle to very little purpose if any one has received the impression that it was intended to warn a trustful public either against Jay Gould or his newspaper. People who think that either would scruple to act dishonestly or speak falsely are beyond the reach of any argument of ours.—*N. Y. Times.*

It is interesting to be assured by that precious humbug of a journal, the *Times*, that "it would be difficult by any new revelation of trickery or rascality to add anything to the well-established reputation of Jay Gould." Was it on this account that the nominal chief stockholder of the *Times* went on all fours the other day before Mr. Jay Gould to solicit from him a subscription of $25,000 in aid of a fund nominally raised by the *Times* as a gift to General Grant, on the interest of which while the principal lay in his hands this nominal chief stockholder of the *Times* is understood to have made a neat little foreign tour, in the course of which he did *not* pay his respects to the able London correspondent of the *World*.—*N. Y. World.*

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THE CITY'S BULKHEAD WALL.

About the middle of last September the Dock Commissioners appointed General Newton and General Gilmore, of the army engineers, and Mr. W. E. Worthen, civil engineer, a Board of Consulting Engineers to examine the bulkhead wall now building by the department, and report whether or not it was good and suitable, and if not, how it could be made so.

This board sent their report to the Dock Department on the 28th ult., and it is very full and clear. They state that they have made thorough and complete investigation into the wall and everything connected with it, and have tested some of the processes of construction, the resistance of the piles, the slope of the walls—both old and new—and various other details.

The following is a summary of their conclusions: There are no movements of the wall other than were to be expected in such a bottom. The movements have not in any way lessened the stability or durability of the wall, and there is no indication that they will do so.

All the woodwork in the wall is thoroughly protected against decay and against the ship-worm.

The new system of capping piles under water to bear heavy weights by placing upon them a bed of mortar inclosed in bagging is both effective and economical.

As a whole, the plan upon which the wall is at present built combines the necessary elements of strength and durability, is ample in its dimensions, is sufficiently safe against tipping, and so far has been well and faithfully built.

They recommend some slight changes, but nothing essential, such as cheapening the cost of the concrete by using natural cement instead of Portland cement, and placing more stone in front of the wall at its base in case any of such stone should be accidentally removed, and conclude their very complete and able report with the following:

"The present cross-section of the wall as designed by your engineer-in-chief we regard as founded on correct principles of stability and economy, and the modifications we suggest seem to us to improve it without changing the ideas characteristic of the plan."

This report is doubtless very gratifying to Mr. Greene, the Engineer-in-Chief of the department, who designed the wall and has superintended its construction, and also to the Commissioners, who approved his plans and ordered the work, and finally to the taxpayers, who have to foot the bills; and in view of this approval from the highest authority the various criticisms upon this wall which have appeared during the past few years would appear to be the work of either incompetent or interested persons.

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NOTES.

WHEN THE PLUMBERS FIRST BEGAN IT.

The ordinances of the plumbers, approved by the Mayor and Aldermen of London in the thirtieth year of Edward III., ordain "that every one of the trade shall do his work well and lawfully, and that for working a clove of lead for gutters or for roofs of houses he shall take only ½d., and for working a clove for furnaces, belfrys and conduit pipes, 1d. Also, that no one for any singular profit shall engross lead coming to the said city for sale, to the damage of the commonalty, but that all persons of the said trade, as well poor as rich, shall be partners therein at their desire." There were many ordinances, both royal and municipal, in the fourteenth century for the sale of various commodities "at reasonable prices." The general standard of "reasonable" or fair price and profit was custom. Where the seasons, as in the case of food, or other circumstances made a customary price impossible, the local authorities or the central government itself intervened to prevent sellers from taking advantage of the necessities of buyers. There was abundance of self-seeking and greed of lucre, as well as of hypocrisy, in the mediæval world, but they worked not through competition but through combination; towns, guilds, companies, classes, grasping at exclusive privileges, monopolies and gains. Men pursued their prey, as it were, in troops and packs. What was sought was not the gain of individuals as such, but of communities, corporations, fraternities and orders.—*The Fortnightly Review.*

THE WEIGHT OF A MILLION DOLLARS.

In answer to an inquiry by Assistant Secretary French, the Government actuary, Mr. E. B. Elliott, has furnished the following information as to the weight of a million of standard gold dollars and that of the same number of standard silver dollars:

The standard gold dollar of the United States contains of gold of nine-tenths fineness 25.8 grains, and the standard silver dollar contains of silver of nine-tenths fineness 412.5 grains.

One million standard gold dollars, consequently, weigh 25,800,000 grains, or 53,750 ounces troy, or 4,479 1-6 pounds troy of 5,760 grains each, or 3,685.71 pounds avoirdupois of 7,000 grains each, or 1 843–1,000 "short" ton of 2,000 pounds avoirdupois each, or 1 645–1,000 "long" ton of 2,200 pounds avoirdupois each.

One million standard silver dollars weigh 412,500,000 grains, or 859,375 ounces troy, or 71,614.58 pounds troy, or 58,928.57 pounds avoirdupois, or 29 464–1,000 "short" tons of 2,000 pounds avoirdupois each, or 26 307–1,000 "long" tons of 2,240 pounds avoirdupois each.

In round numbers the following table represents the weight of a million dollars in the coins named:

Description of coin.	Tons.
Standard gold coin	1[illegible]
Standard silver coin	[illegible]
Subsidiary silver coin	25
Minor coin, five-cent nickel	100

NUTMEGS

Grow on little trees which look like little pear trees, and are generally not over twenty feet high. The flowers are very much like the lily of the valley. They are pale and very fragrant. The nutmeg is the seed of the fruit, and mace is the thin covering over the seed. The fruit is about as large as a peach. When ripe it breaks open and shows a little nut inside. The trees grow on the islands of Asia and tropical America. They bear for seventy or eighty years, having ripe fruit upon them all the seasons. A fine tree in Jamaica has over 4,000 nutmegs on it every year. The Dutch used to have all this nutmeg trade, as they owned the Banda Islands and conquered all other traders and destroyed the trees. To keep the price up they once burned three piles of nutmegs each of which was as big as a church. Nature did not sympathize with such meanness. The nutmeg pigeon, found on the Indian islands, did for the world what the Dutch had determined should not be done—carried these nuts, which are their food, into all the surrounding countries, and trees grew again and the world had the benefit.

THE GROWTH OF LONDON.

The extraordinarily rapid growth of London in recent years has become a source of some anxiety to the Metropolitan Board of Works, which finds it an almost impossible task to superintend the draining and lighting of the new districts, which now extend continuously to Turnham Green in one direction and to Ealing in another. On the Surrey side of the river Thames no less activity is shown by the builders, and Sydenham, Chiselhurst, Wimbledon and Peckham Rye are now joined to the metropolis. The multitude of new houses are chiefly of a kind to suit persons whose incomes are moderate, and many of them are constructed to accommodate two small families. French flats, however, are not in favor in England, although a few of them may be found in Edinburgh. While these extensive accommodations have been prepared for the middle classes of London, the dwellings of the laboring people have been greatly improved. The filthy, fever-stricken dens which used to exist in the vicinity of Drury Lane, Gray's Inn Road, Smithfield and Chelsea Hospital have been swept away, and on their sites immense tenement houses erected, in which respectable artisans can find cheap and comparatively comfortable homes.

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U. P. R. CONSTRUCTION.—During the year 1881 the Union Pacific Railway Company has laid 328 miles of track in Colorado, Wyoming and Montana. The extensions represented by this mileage are as follows: Julesburg Branch, 151 miles; Denver and South Park branches, 26 miles; Utah and Northern Extension, 66 miles; Greeley, Salt Lake & Pacific Branch, 10 miles; Oregon Branch, 75 miles. These new lines bring the grand total of track owned and operated by the Union Pacific up to 3,748 miles. Passenger trains are not yet running over the Oregon and Greeley, Salt Lake and Pacific branches, but regular trains run over every other mile represented by these figures.

SHAFT SINKING UNDER DIFFICULTIES AT DORCHESTER BAY TUNNEL, BOSTON, MASS.*

BY D. MCN. STAUFFER, MEM. A. S. C. E.

The body of this paper will be devoted to a detail of actual experience in shaft building under difficult circumstances; but that the existing local conditions may be better understood we will commence by a short general sketch of the work with which these shafts are immediately connected.

The system of improved sewerage, now being carried out by the city of Boston, is too extensive and complex in its ramifications to be treated of in this paper. We will, therefore, begin at the pumping station on Old Harbor Point, the terminus of the low-grade intercepting sewers.

The sewage, in passing from the pumping station to the point of final delivery on Moon Island, must cross under Dorchester Bay, a navigable arm of Boston harbor, about two miles wide from shore to shore; and to this end an inverted syphon or submarine tunnel becomes necessary.

After an examination into the geological formation of this region, it was determined to locate the horizontal portion of the syphon at a sufficient depth below the surface of the water to be entirely contained *within* the rock which was found to underlie the bay. This determination fixed the average invert grade of the finished tunnel about 142 ft. below mean low tide, or Boston City datum. The ship channel is only 18 ft. deep at low water, but the material overlying the rock was mud, clay, sand and gravel, so irregular in its deposit, and so unreliable in its general character, that tunneling through it was an impossibility with the Atlantic ocean practically overhead.

The rock to be passed through belongs to the clay-slates, with, so far, infrequent strata of very hard conglomerates. But at some remote period this ancient sea floor, in taking its present trough-like shape, has been subjected to enormous pressures, much disturbing the original stratification, breaking the beds in many places and leaving them tilted at high angles to the horizon. The numerous faults consequent on this action, have generally well filled again by injective material, but crevices, fortunately slight in extent, are frequent, which communicate more or less directly with a water-bearing stratum of sand, gravel and boulders, which seems to be continuous over the surface of the rock. Wherever cut by the tunnel section, these seams allow a greater or less percolation of sea water into the workings below, amounting at his date (July, 1881), to 1¼ millions of gallons daily, which can, of course, only be removed by constant pumping; the length of the tunnel now excavated being 4,600 ft.

The lower plate is a general profile of the tunnel, and shows the rock dipping rapidly from east to west. To meet this rock at as high an elevation as possible, the western, or inlet shaft, was pushed out about 1,400 ft. from the Boston shore of the bay, and connection made between it and the pumping station, by a high-grade tank sewer, founded upon an embankment, and protected by rip-rap and a sea-wall. Four pumps, of a capacity of 25,000,000 gallons each, daily, will raise the sewage a height of about 43 ft., and deliver it into this tank-sewer, the invert grade of which is 15.5 ft. above city datum. This tank is double, each section being 8 ft. wide by 16 ft. high, and the interior is provided with a series of dams, which will intercept any heavy material that may pass through the screens provided at the entrance to the pump well. Either compartment of the tank can be shut off by gates, and cleaned, and by means of stop planks the velocity head can be greatly increased and the tank sewer used to flush out the tunnel, sea-water being pumped into the tank for this purpose.

At the inlet shaft, the bottom of which is 143 ft. below datum, the tunnel commences, and runs in a south-eastwardly direction for a distance of 6,090 ft., to the center of the east shaft, the bottom of which is 144 ft. below datum; at this latter point the tunnel grade commences to rise at the rate of 1 ft. vertical in 6 ft. horizontal, and continues at this grade for a further horizontal distance of 903 ft., until the tunnel pierces the surface of the ground on Squantum Head, which forms the eastern side of Dorchester Bay.

At the eastern terminus of the tunnel, the invert grade is 14.4 ft. above datum, and from this point the sewer is continued in an open cut across Squantum Head, and then on an embankment over the shoal water lying between the Head and Moon Island, to the collecting basin on the island, from which basin the sewage is emptied into the bay at each ebb tide by an appropriate system of gates and outfall chambers. The point of discharge is four and one-half miles in a direct line from the State House in Boston.

DIMENSIONS OF TUNNEL AND SHAFTS.—The tunnel and the shafts are circular in section, with a finished inside diameter of 7 ft. 6 in. The tunnel and shaft excavation, as at first taken out, is as near as may be 9 ft. 6 in. in diameter, provision being thus made for a final lining of brick work throughout, 12 in. thick, for the purpose of reducing friction. This brick work is intended to be water tight, and at the inlet shaft gates and an outfall sewer will be built, leading from the tank sewer, so that the sewage can be discharged directly into the bay at this point and the tunnel pumped out, examined and cleansed, when such a proceeding may be deemed necessary. To intercept any solid matter that may pass into the tunnel, a sump 6 ft. deep is provided at the bottom of the east shaft, and consequently at the foot of the incline, from which sump the material may be removed by dredging through the shaft. The middle shaft, shown on the profile, is simply for working purposes, and may be finally filled up.

BULKHEADS ABOUT SHAFTS.—As all the shafts are located in water, from 3 ft. to 15 ft. in depth, depending upon the state of the tide, bulkheads were necessary, from which to commence operations, and to protect the mouth of the shaft from damage by storm, ice, passing vessels, etc. As shown at Figs. 1 and 2, Plate I., these bulkheads consisted substantially of a box 20 ft. square inside, formed of oak piles driven 2½ ft. apart from centers, and capped by 12-in. × 12-in. hard-pine sticks, framed at the corners, and drift-bolted to the head of each pile. These caps were further secured at the corners by 12-in. × 12-in. angle-braces, dovetailed into them. The box was lined inside by 4-in. tongued and grooved sheet-piling, driven to hard bottom, and well spiked to four lines of 4 in. × 10-in. inside wale pieces. Outside of the piles were two sets of 12-in. × 12-in. hard-pine timbers, spaced 4 ft. apart vertically, and bolted to the piles by 1¼-in. bolts, and tied at the corners of each set by 2-in. diagonal rods. The top of this bulkhead was 18 ft. above mean low tide, the average rise and fall of tide being 10 ft. After the iron cylinder had been started within this box, the space surrounding the cylinder was compactly filled with puddle clay.

THE IRON CYLINDERS.—To quote from the specifications, "Iron cylinders were to be sunk to a depth sufficient to give them a firm bearing, to insure the exclusion of tide-water, and to pass through ground otherwise difficult to excavate." These cylinders are 9 ft. 6 in. inside diameter, 1⅜ in. thick, and cast in solid sections 5 ft. long. The flanges are 5¼ in. wide over all, 2 in. thick, and faced true for a width of 4½ in. in from the exterior edge. A groove ⅛ in. wide, and 1⅜ in. deep, was left between any two abutting cylinders, on the inside, to be caulked with lead if found necessary. The sections were connected by thirty turned bolts, 1⅛ in. diameter, in each joint, and the bottom section in each shaft was provided with a cutting edge, 12 in. deep. The weight of each section was 5 tons, or 1 ton to the lineal foot of iron cylinder. The joints were made water-tight, by first painting them with thick red lead, and then passing four turns of cotton wicking, dipped in the paint, around the outside line of the bolt holes; grummets of the same wicking, dipped in paint, were put under the heads and nuts of all the connecting bolts. These joints proved perfectly water-tight.

SINKING THE CYLINDERS.—After the bulkheads were completed, pile wharves had to be built adjoining them, upon which to place the hoisting engines, boilers, coal bins, fresh-water tanks, etc. To handle the five-ton cylinder sections, four stout shear-poles were erected, resting on the corners of the bulkhead and meeting at the top, over the center of the proposed shaft, where the ends were secured by rope-lashing (Fig. 1, Plate I). A hoisting tackle of two triple-sheaved "masting-blocks," and 4-in. manilla rope was suspended from the apex of these shears. Owing to delay in obtaining the proper kind of clay filling, and to avoid the increased friction as well, the first five cylinder sections in each shaft were put in place by means of friction clamps, as shown at Fig. 2, Plate I. These clamps were made of two compound beams of hard-pine timber, thrown across the bulkhead, one each side of the cylinder. Each beam was composed of three 12-in. × 20-in. sticks, the inner one of each beam being carefully fitted to the outside of the cylinder; to increase the friction, four vertical timbers, 12-in. × 12-in. and 4 ft. long, were bolted to the inside of the beams, as shown on the plan. The clamps were drawn together and made to hold any object between them, by tightening up the nuts on two 2¼-in. iron rods that passed through the beams, one each side of the cylinder section. We should here remark that, owing to its resinous nature, hard pine is not well adapted for use in that part of the beam touching the cylinder; white pine is much better, but in our case could not be obtained in time of the required dimensions. The method of operating these friction clamps was as follows: No. 1 section was first lowered down between the beams, and clamped fast. No. 2 section was next lowered down upon No. 1, the joint made, and the connecting bolts put in and screwed up; with the hoisting tackle still attached to the last section as a "preventer," the two sections were allowed to slip down between the clamp beams in a series of short jumps, by carefully slackening and then tightening the nuts on the clamp-rods with a long wrench. A little practice enabled the workmen to keep the mass under perfect control. When No. 2 section occupied the place in the clamps previously held by No. 1, the nuts were screwed up tight, the tackle cast off, and the third section bolted on, and lowered in like manner. This process was repeated until the cutting edge on the first section had reached hard bottom, when the clamps were loosened, and thereafter utilized as guides.

HANDLING THE MATERIAL EXCAVATED.—Before the permanent hoisting cages were put in place, the material excavated in sinking the shafts, and in driving a considerable portion of the tunnel as well, was handled by an arrangement shown at Fig. 1, Plate I. This was simply an out-haul, working through a single block lashed to the head of a mast planted in the bulkhead; this mast leaned outward at the top—over the side of the bulkhead. In using this arrangement, the bucket is hoisted a distance above the shaft, fixed by experiment—the out-haul being hooked on to the bucket just as it reaches the mouth of the shaft—and the slack hauled in as the bucket ascends; when the bucket stops, the end of the out-hall is made fast to a cleat on the mast, and the bucket in descending will pass through a curve regulated by the length of the out-hall, until it hangs vertically from the top of the mast, and over the sides of the bulkhead, where it can be dumped. A reversal of this process will bring the bucket again to the top of the shaft, where the out-haul is unhooked, and the bucket lowered to the bottom for refilling.

SINKING WEST OR INLET SHAFT.—All of the foregoing description applies to the three shafts, generally. We will now confine our remarks to the west shaft, where the depth of the material overlying the rock was greatest, and the difficulty of sinking in like degree increased.

Previous to the letting of the contract, test borings had been made over the line of the tunnel by the city of Boston, and the results exhibited.

Owing to the great expense of so doing, these borings in no place penetrated the rock proper, and, therefore, they failed to give any certain indication of the presence, at each shaft at least, of a stratum of boulders, sand and gravel, lying immediately on the rock, and containing a large body of water. At this west shaft, especially, the worst feature shown by the borings was a sandy clay. The tunnel grade had to be finally lowered 8½ ft. below contract grade to meet this changed condition of affairs.

The material was actually deposited at the west shaft, in about the following sequence: Commencing at the top, mud 8 ft., pure sand 5 ft., and then strata of varying thicknesses of pure, tough clay—clay with thin seams of fine sand, and clay intimately mixed with sand. Above the surface of the solid rock, and meeting the clay and sand deposits, was a stratum 14 ft. thick, of large boulders, gravel and very sharp sand, and in this lowermost stratum water to the amount of about 17,000 gallons per hour was found. This water was salt and seemingly in direct communication with the bay above.

In the sand seams struck before the boulder stratum was tapped, brackish water, in maximum quantity not exceeding 200 gallons per hour, was found, but these seams generally drained out and gave little or no trouble. The surface of the solid rock was finally located at the west shaft 128 ft. below city datum.

Seven cylinder sections, making 35 lineal feet of iron shafting, were sunk without much trouble, but at this point the frictional resistance of the clay was sufficient to prevent any further sinking of the iron lining by its own weight merely, although the material was excavated below the cutting edge. At this time the surface water was entirely excluded, and the shaft was dry. A dead weight of at first 50 tons was now applied as follows: On top of the flanges forming the second cylinder joint, or 10 ft. from the bottom of the shaft, a platform was built, made of 4 12-in. × 12-in. hard pine sticks, laid in pairs, parallel to each other, leaving a 6-in. space between the two sticks in each pair, and a space of 4 ft. between the pairs. These four sticks were accurately fitted to the inside of the cylinder with as great a bearing surface on the flanges as was possible, holes being made in them for the heads of the cylinder bolts. Two struts 12 in. × 12 in. and 4 ft. long, were let in between the pairs, and at right angles to them, so as to leave a central opening 4 ft. square, opposite the ends of these struts and between the sticks forming the pairs, four wedges were now driven and the whole structure thus secured in the cylinder. A shaft 4 ft. square inside, made of 4-in. plank, on end, and internally braced, was next erected on this platform, and the space outside this box shaft well packed with iron refuse from a puddling furnace. As the cylinder descended and the friction became greater, this dead weight was increased to a little over 100 tons by putting in a second platform and box higher up in the shaft. Eight heavy screw-jacks were also applied, in addition to this weight, on the top flange of the cylinder, reacting against trussed beams, secured by chains to the bulkhead piles.

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* Read before the American Society of Civil Engineers, Sept. 21, 1881.

When the cutting edge of the shaft-lining had reached a point 57 feet below city datum, the area of surface then exposed to possible friction being over 1,800 sq. ft., all our combined appliances failed to push it any further, and the use of the specified solid iron cylinders had to be discontinued.

CONTINUATION OF THE SHAFT TO ROCK.—No plan whatever of continuing the shaft after the cylinders were pushed as far as was possible being specified, the contractor was at liberty to adopt any method that might seem to him most fitting. From the data before him timber was deemed sufficient, and a timber lining was adopted: the shaft was dry, all water from above excluded, and nothing but clay indicated below him until the rock was reached. Of the wisdom of this decision we will here say nothing, considering that all the known data was derived from deep borings—which more often lead to trouble than exhibit the actual condition of affairs.

The timber shaft was 10 ft. square inside, and built of 12 in.×12 in. spruce timber, laid skin to skin. As shown at Fig. 4, Plate II., the sticks were cut and laid in alternate lengths of 10 ft. and 12 ft., locking over each other at the corners, and to prevent the shorter timbers from being forced inward they abutted against cleats 4 in.× 10 in.×16 in., well spiked to the long sticks. They were further held in place by the bracing described further on.

The first timber course laid was only 8 ft. 10 in. square inside, each succeeding course stepping back 2 in., until the full dimension of 10 ft. square was reached. This was done to give the cutting edge of the iron cylinders a bearing on top of the timber work, at least in the center of the four sides. Between the top course of the timber-work and the iron, a space 4 in. wide was left, in which 4-in. sheet piling was driven out horizontally into the clay and the corners outside the circle thus closed.

The greatest difficulty to be dealt with from the start, and the chief objection against such a compound shaft of iron and wood, was that of properly connecting the two. The corners of a square wooden shaft are the points best adapted for the location of any suspending members, but in our case these corners were outside the cylinder, and, consequently, not available. At first four of the cylinder bolts were removed from the bottom joint in the cylinder and replaced by four 1⅛-in. rods, with nuts at the top and lipped plates, catching under the bottom of the second timber course, and secured by 1-in. rag bolts to this course; below this the hanging was continued by vertical plank spiked to the timbers.

As the shaft increased in length, these 1⅛-in. rods were supplemented by four rods 2 in. in diameter, suspended opposite the center of each side of the shaft, from heavy iron castings, bolted on top of the second cylinder joint. An iron plate 6 in.×⅜in. and 8 ft. long, was bolted by eight 1-in. bolts, to the middle of each side, and at the top of this plate was an L-shaped head 8 in. 1×½ in., through which the 2-in. rod passed, and was there secured by a nut.

This timber shaft was sunk with very little trouble to a point 95 ft. below datum, with a maximum quantity of water from the thin sand seams not exceeding 200 gallons per hour. But at the point first mentioned, water suddenly burst in from below at the rate of about 10,000 gallons per hour, driving out the workmen and rapidly filling the shaft, to low-tide mark. A steam pump was at once put in place and the shaft again emptied. An examination showed that, while the source was at some point below the bottom of the shaft, the water had in places forced its way up behind the timbering and was entering the shaft in jets through every possible crevice. And, what was worse, the main stream was undermining the sides at the bottom, and the jets above were washing the fine sand inside, leaving voids outside the shaft-lining. The sides were at once calked, and the water driven to the bottom, and the 8 in. × 8 in. bracing, only partly in place, was completed to within 4 ft. of the bottom. The iron cylinder soon commenced to sink very slowly, showing that the ground surrounding the shaft was in motion clear to the surface. The bulkhead and the adjoining portion of the machinery wharf sank with the cylinder.

The bottom was now a sandy clay, the water passing to the southwest corner of the shaft as soon as we commenced resinking. The material to the east and north side seemed to drain out and remain quite firm, while on the other sides it soon became very soft, in places semi-fluid. This action increased the strain on the soft sides and tended to throw the timber courses out of the horizontal, the west side sinking more rapidly than the east. As long as the bottom remained firm, this inequality of settlement was arrested by "rakers" and "props." All timbering on the soft sides could only be put in place by first carefully poling those sides, but surplus material would escape inside, and increase the pressures. All went well enough under the circumstances until we reached grade 104, when we suddenly struck a stratum of soft, almost dough-like clay, which we afterwards found was the direct covering of the water-bearing stratum of boulders, etc. Into this soft material our rakers, props, etc., easily sank and became useless as supports, and thereby the strain upon the rods and hanging members on the soft sides was enormously increased, and the west and south 2-in. rods both broke, just above the lower nuts; the immediate cause being the slight bending of the L-shaped heads of the straps, thus acting as levers on the nuts and ends of the rods. Some of the plank lacing also commenced to give way, and, being behind the corner bracing, could not be repaired.

Two steam pumps, a No. 8 Blake, and a No. 10 Knowles, were at this time located in the timber portion of the shaft, supported upon platforms, the discharge and steam pipes were clamped to both the iron cylinder and to the sides of the wooden shaft. As soon as the 2-in. rods broke, severing the connection on those sides between the iron and the wood, the lower portion began to settle more rapidly than the cylinder. The effect of this was to break the bottom elbow on the discharge column of our large pump, flooding the lower portion of the shaft to the height of the suction on our reserve pump, the No. 8, at a very critical period. This damage was repaired as soon as possible, and a re-occurrence of the accident prevented by slinging both of our pumps by wire rope to the iron cylinder, and wedging up between pump and platform as the wooden shaft settled.

On sounding through the soft stratum hard bottom was found about 7 ft. below the then bottom of the shaft, and, as this was very near the point which the boring indicated as rock, we continued sinking. After some tedious and dangerous work, and much trouble and delay from our pumps, which, as is usually the case, were always breaking down just when most needed, we reached the hard bottom only to find it was not ledge rock, but the top of a boulder stratum, of then unknown depth, and the source from whence came all our water, now much increased in quantity. The sand in this deposit was unusually sharp, and would scour through a brass pump lining ¼ in. thick in less than three days, causing further and dangerous delays.

We attempted to sound the boulder stratum by driving iron bars, but failed to get any satisfactory results until we started an artesian boring in a 5-in. pipe, and finally drilled some 8 ft. into the rock, establishing its actual depth and character.

At this time the bottom portion of our timber shaft was in very bad shape, many timbers broken, the hanging appliances a failure, and the courses very much out of the horizontal. To continue sinking under these conditions was to invite certain disaster. On the other hand, if we stopped sinking, the only alternative to building a new shaft in another location was the somewhat desperate one of attempting to retimber the lower 36 ft. of the shaft in the face of the moving ground and the consequent pressures. We determined to retimber without waiting for the ground to settle.

The upper 23 ft. of the timber work was still in good condition, the courses almost level, and the lacing intact. This portion we concluded to leave in, but it had, first of all, to be securely connected with the iron cylinders, and upon the integrity of this connection all success depended. Iron rods were abandoned in our plans for several reasons, among these the difficulty of attachment, and the fact that in one place certain obstructions in the shaft prevented a fair lead. Iron-wire cables were substituted for rods. Four cables, made by Roebling Bros., were at first used, each cable 6⅛ in. in circumference and 22½ ft. long from bearing to bearing of the eyes, and thimbles spliced into each end. The upper eye was made heart-shaped, so that the lashing to be used would not ride and cut under the strain to be put upon it, the lower eye was made to take a 2-in. iron pin, and the splices on each cable were further secured by broad iron clamps bolted over them. On top of the first or lowermost cylinder joint, two hard pine timbers, 12-in. × 20-in., were placed, after having first been accurately fitted to the inside of the cylinder; holes were bored vertically through these sticks, just clearing the cylinder flanges, and passing through these holes, secured above by nuts and 12-in. cast-iron washers, were four eye-bolts made of 2½-in round iron; two struts were driven between the 12-in. × 20-in timbers, to prevent motion.

The lower connection for the cables was more troublesome. At the point selected, two hard-pine beams, 12-in. × 20-in. and 12 ft. long, were inserted in the shaft horizontally, the ends extending out under the sides. These two beams ran in the same direction as the shorter beams in the cylinder, and were vertically under them. Around each of the 12-ft. beams, and directly under the eye-bolts, were four iron stirrups, each 6 in. by 1 in., with two eyes in each stirrup just over the center of the beam.

Between these eyes the lower end of the cable was inserted and secured by a 2-in. iron pin. The upper eye of each cable was now lashed to its proper eye-bolt by steel wire rope set taut by a purchase connected with the hoisting engine.

The connection being now completed between the iron cylinder and the 26 ft. of wood work to be left in place, the workmen commended replacing the old cripled timbers, below the hanging beams, with new and level courses; in other words, rebuilding the lower portion of the shaft. As shown on Fig. 1, plate II., a system of timber hanging was first attempted with 4-in. plank, which plank acted at the same time as struts for the corner braces. This system was soon abandoned. It was all right theoretically, and had it been as easy of application in the shaft as on paper, would no doubt have answered admirably, but in practice it was found impossible, under the circumstances, to keep the inside faces of the timbers sufficiently true to plank against in the manner intended. The same principle was, however, retained by using iron straps 3 in. × ⅜ in., and 4 ft. long, spiked with 10-in. wrought-iron spikes to the timber. These straps were applied in the corners behind the braces, in such manner that each new stick was suspended by two of these straps as soon as it was in place—4 ft of the bottom of the shaft was necessarily left unbraced for convenience in working.

A second set of hanging timbers was put in 20 ft. below the first, and entirely independent of that set (Fig. 1, Plate II.). In this set each hanging beam was made up of two 12 by 12 in. timbers, placed one on top of the other; the upper one was 12 ft. long and passed through the sides of the shaft, the lower one was 10 ft. long, and acted as a strut as well. Two 2-in. iron rods, about 10 ft. long, each provided with an eye for a 2-in. pin above and a nut below, secured the lower end of each secondary cable to the beams. These rods, in pairs, carried the compound beams between them, the lower ends of each pair of rods passing through a stirrup plate 8 by 1½ in. under the bottom stick, and there secured by nuts. These cables were galvanized iron wire 4½ in. in circumference. They were lashed at the upper end to four 2-in. eye-bolts, which passed through castings bolted on to the second cylinder joint.

This re-timbering was slow and dangerous work, and the greatest care possible in poling could not prevent the escape of some of the outside material into the shaft. The voids thus created, though comparatively slight, kept the ground in constant motion, the settlement being apparent clear to the surface. The first wire cables soon became as taut as harp strings. At first the greatest weight was thrown on the western pair of cables, leaving the east cables comparatively slack; the strain on the cables was equalized by setting up rakers, extending from the heavy west side to the east end of the main hanging-beams. The total settlement of the iron cylinder after the timbering was commenced was just 5 ft.

The timber shaft was in the above manner successfully carried down to the solid rock, the shaft continued 20 ft. into the rock and the tunnel commenced. About five months after the completion of the timber-work the brick lining was commenced. To conform to required lines it was necessary to cut entirely through some of the shaft timbers, and at the center we found the clay outside generally drained, and in good condition. In the time specified above, the brick-work was completed with but little trouble from any motion in the adjoining ground; caution, however, was required, and the work was slowly and carefully done.

PUMPING OUT SHAFTS.—The west and the east shafts were at different times filled with water; the first was lost by a failure of our boilers, the other by suddenly uncovering an unusually large seam in the rock, through which more water entered the tunnel than could be handled with safety by the two pumps then in place—one of the pumps broke down under the hard work, and the tunnel and shaft filled up. All of our shafts were too small in diameter, when their depth and the quantity of water to be raised through them is considered. This want of shaft room made our method of regaining them somewhat peculiar, and we will relate our experience.

When the eastern shaft was flooded the amount of water to be pumped against was 18,000 gallons per hour, constantly flowing into the tunnel. To handle this quantity of water with safety, under the working conditions, would require a pump of the capacity of a No. 11 Knowles, which measures 9 ft. over all, and would require an additional 2½ ft. of room at the water end to allow packing, etc. It can be readily seen that such a pump could not be located horizontally within the iron cylinders, which, as before mentioned, were only 9 ft 6 in. in diameter, a space further reduced by the flanges to 8 ft. 10 in.

To overcome this difficulty we had a special pump built by the Knowles Company, of the bucket and plunger type, double-acting and working vertically. This pump had a 14-in. steam cylinder, 12-in. plunger, 17-in. bucket and 24-in. stroke: its capacity was 11$\frac{3}{4}$ gallons per stroke. (The steam cylinder proved too small for the work to be done; it should have been 16 in.) The pump was 12 ft. long over all, and 3 ft. in diameter at the widest part, and with 20 ft. of thin wrought-iron suction pipe 10 in. in diameter attached, weighed 7,000 lbs. The steam pipe was 2-in., the exhaust 3-in., and the discharge column was 6-in. galvanized-iron spiral pipe in 16-ft. lengths, connected by flanges and 6 $\frac{7}{8}$-in. bolts.

On account of its shape this pump was used without platforms built in the shaft. Two heavy beams were thrown across the top of the shaft cylinders, and from these the pump was suspended by a purchase made up of two large triple-sheaved masting blocks, and six parts of 4-in. Manilla rope, connection with the pump being made by a strong eye-bolt screwed into the head of the steam cylinder, and by chain slings passing down to the water barrel of the pump. The running end of this purchase passed from the lower block up to a large single block lashed to the top of the four-legged shears, shown at Fig. 1, Plate I., and from there down to the wharf, and through a snatch-block to the drum of the hoisting engine. The 6-in. discharge column, and the 2-in. steam pipe were clamped to separate steel wire ropes, that were secured to the pump below, and thence passed over sheaves lashed to the shears near the top, but as far apart as possible; from these sheaves each rope went through a snatch-block on the wharf, and then to large cleats, all so arranged that each rope could be paid out steadily, and independently, as the pump was lowered. The exhaust steam passed into the water. To keep the pump from moving laterally when it was at work, oak slides, with clamping screws, were attached to the pump, so that they could be pushed out against the sides of the shaft and then clamped. The spreading of the blocks to which the discharge and steam pipes were suspended was to overcome the twisting tendency in the falls.

The method of operating this pump was as follows: When the water in the shaft had been pumped down as low as possible, the steam was shut off at the boiler, the top elbow and a 10-ft. length of horizontal pipe was taken off from the discharge column, and a 16-ft. length added to the discharge vertically. The steam pipe was, at the same time, being disconnected at a union provided for that purpose just at the top of the shaft, and a new 16-ft. length screwed on. While this was being done on top, another gang of men, stationed on the pump to prevent twisting in lowering, had hauled in the slides mentioned above. All being now ready for a shift, the engineer lowered the pump slowly, and the men stationed at the discharge and steam pipe ropes allowed these pipes to descend with the pump, until the top of the newly added section of steam pipe was just opposite the union; all ropes were at once secured, connection made with the boiler, and the upper discharge elbow and its pipe again bolted in place, the men on the pump adjusted and secured the slides, and all was once more in position, ready to pump out another 16 ft. of the shaft. After the men became expert in their several duties the time required to make shift was about 25 minutes, computing from the stoppage of the pump to the starting again.

But simple as the above may appear, it was only after repeated trials and failures, and considerable experimenting, that the wished for result was attained. At the east shaft we reached the tunnel grade with our suction pipe 166 ft. below the top five several times before we could stay there long enough to pump out the 500 lineal feet of tunnel already driven. It should be remembered that the plunger, as we called it, was only an emergency pump intended to empty the shaft and tunnel preparatory to setting up a large permanent pump of the horizontal type in the tunnel. The vertical pump was troublesome to handle, took up much room with its ropes and pipes, and was difficult to pack.

The steam connection was the most troublesome feature. When the pump was in action there was a very remarkable vertical motion due to the elasticity of the fall ropes. This was especially the case when we neared the bottom of the shaft, and a rigid connection was consequently impossible. After trying a jointed steam pipe without success, we made use of a 6-ply gum and canvas steam hose, 6 ft. long, placed between the steam pipe and the steam cylinder on the pump, but, under the steam pressure carried, 100 lbs. at the boiler, this hose burst in a few hours; 10-ply canvas and pure gum was next tried, but even this would sometimes fail by the intense heat softening the gum and thus allowing the hose to blow off of the iron nipples in the end, in spite of grooves and broad iron clamps, intended to prevent any such accident.

The radiation from the steam pipes, and the ascending steam, caused by water falling on the hot cylinder and pipes, made the temperature in the shaft almost unbearable. This, and the entire want of ventilation in the deep and narrow hole, caused great physical suffering among the men whose duties called them inside, especially when this experience was varied by the bursting of a 2-in. steam hose in the face of the pumpman. To the pluck and endurance of these faithful workmen all success was really due. Thus 166 ft. of shaft was finally pumped out in a little less than nine hours. Having, we hope, given a sufficiently detailed description of how we got into a scrape at the west shaft, and how we finally got out of it, we can now look back and see where we made our mistakes.

First of all, it should have been taken as granted that water was to be met with in abundance, under the circumstances, as we neared the rock. All indications to the contrary, obtained from borings, should have been disregarded. Had this been done, in the opinion of the writer, it would have been ill-advised to have used any form of compound shaft, partly wood and partly iron. The iron cylinders should have been continued to the rock, by using iron rings of reduced height, and cut into four or more segments, put into place at the bottom of the shaft, as soon as the friction prevented the further descent of solid cylinder sections and the surface water was excluded. The advantages would have been many as compared with the attempt to hang a square wooden shaft to an iron cylinder, the vertical connection would have been continuous and abundantly strong, and the entire shaft could have been made water-tight by caulking the joints with dry pine wedges, or otherwise. And with rings not more than 2½ ft. in height any soft ground could have been passed by a proper system of poling.

It is true that some hanging appliance similar to finally that used might have been at first put into a timber shaft had the possibility of meeting water been fully considered by all parties concerned, but the experiment, we think, would have been a dangerous one as compared with a continuous iron cylinder, and, all things considered, it would not have been as economical as iron.

NOTE.—The Dorchester Bay Tunnel was commenced in January, 1880, and at this date some 4,600 feet of the tunnel are driven. The contract was let to Mr. R. A. Malone, of Pennsylvania; the writer was engineer for the contractor.

We cannot, in justice, omit the mention of our personal indebtedness to Michael Nolan, who superintended the retimbering of the west shaft, and to William Reardon, the rigger, who put into place our hanging-up appliances. To the pluck, endurance and practical knowledge of these two men very much of the success was due.

ENGINEERS' SOCIETIES.

THE INSTITUTION OF CIVIL ENGINEERS.

The 63d Annual Meeting was held on the 20th ult. From the Annual Report we quote as follows: "It had been pointed out by Thomas Tredgold in 1828, when requested to define the nature and objects of civil engineering, that the domain of the civil engineer would extend with every discovery of science. A comparison of the papers contributed thirty years ago with those of the present day bore out this opinion, as it showed the great changes brought about in the interval in the practice of the profession by the new industrial application of science. Having regard to the increasing number of subjects which occupied the attention of the engineers, it was manifestly important that the papers read at the meetings of the Institution and selected for publication should be so varied as to be useful to its members in whatever branch of the profession they might be engaged. The tendency of modern manufacturing process was to rely more and more upon machinery, the design and construction of which, as it became more elaborate, could no longer be the work of the mere handicraftsman, but called forth the highest powers of the skilled engineer. It thus happened that men were now to be found exercising engineering vocations widely different from those of the designers of roads, bridges and similar public works, who, very erroneously, had often alone been recognized as civil engineers. As the Institution was largely composed of the former class, it was necessary that the range of subjects for papers should be widened, so that all interests might be consulted. The council appealed to the four volumes of Minutes of Proceedings issued since the last annual meeting, as evidence of the success that has been attained in this direction.

The subject matter index to the whole of the publications of the Institution from 1837 to 1879 inclusive, which had been issued in the autumn, might be said to mark an epoch in engineering literature. The approval with which it had been received was evidence that the unobtrusive but painstaking labor of the compilers was fully appreciated. A name index, which would be a complement to the other, was in course of preparation.

During the past year there had been an increase of 52 members, 19 associate members, and 49 students, with a decrease of 6 associates, while the honorary members remained the same. There were on the books on Nov. 30 last 18 honorary members, 1,261 members, 1,406 associate members, 522 associates and 622 students; together, 3,899. At the same date in 1860 the number of members of all classes was exactly 1,000. The student class had only been created fourteen years. In the interval 1462 candidates had been admitted, of whom 400 had since been elected into the corporation and 490 had ceased to belong to the Institution and in most instances to the profession. The deceases had been at the rate of nearly 19 per 1000, and had included several very old members, notably Mr. James Ashwell, the survivor of the five founders of the Institution.

The income last year was £12,308 11s. 5d., besides which the receipts had included £3,076 14s. on account of admission fees and life compositions (which were rigidly treated as capital, and were not used for defraying ordinary expenses), and £431 5s. 6d. from dividends on trust funds. The general expenditure had amounted to £12,093 7s. 11d., including £6,523 17s. 8d. for four volumes of Minutes of Proceedings and for the subject-matter index. A sum of £3,000 had been invested, and £390 0s. 1d. had been expended for premiums and prizes under trust. The cash balance in hand was £771 12s. 1d., being £424 2s. 11d. above what it was at the same period in 1880. The income had been nearly 4 per cent., and the total receipts 6 per cent. in excess of the previous year.

The following gentlemen were duly elected to serve on the Council for the ensuing year: Sir W. G. Armstrong, C. B., President; Mr. J. Brunlees, Sir J. W. Bazalgette, C. B., Sir Frederick Bramwell and Mr. E. Woods, Vice-Presidents; Mr. B. Baker, Mr. G. Berkley, Mr. G. B. Bruce, Sir John Coode, Mr. E. A. Cowper, Mr. J. N. Douglass, Mr. A. Giles, Mr. H. Hayter, Dr. W. Pole, Mr. Rawlinson, C. B., Mr. A. M. Rendel, Dr. C. W. Siemens, Mr. D. Stevenson, Sir William Thomson and Sir S. Whitworth, Bart., other members of Council.

WESTERN SOCIETY OF ENGINEERS.

At the annual meeting of the Society on the 3d, the following officers were elected for the ensuing year: President, W. S. Baker; First Vice-President, D. C. Cregier; Second Vice-President, K. F. Booth; Secretary, L. P. Morehouse; Treasurer, Charles Fitzsimmons; Librarian, John W. Weston; Trustee for three years, W. S. MacHarg. The annual report of the Secretary showed an increased membership and encouraging interest in the Society. A paper was read, and some minor business was transacted.

POLYTECHNIC ASSOCIATION.

At the regular meeting of the Association held Thursday evening, Jan. 5, Thomas D. Stetson, Esq., presiding. Mr. John Banvard read a paper on common lime mortar and hydraulic cement. He remarked that English authorities, with more patriotism than truth, state that hydraulic cement was first made in that country in 1796, giving the impression that the properties of such limes had never been known and made available. The fact is, on the contrary, that they had been known in Italy certainly as early as Vitruvius. Any good lime, with a proper quantity of clay, intimately combined, would make such cement. The best of all is made by finely grinding broken bricks or finer articles of pottery, and thoroughly incorporating the previously burned clay with the lime mortar.

The proportion of the constituents in the mortar in the great Pyramid of Cheops, the oldest building known, is two of sand to one of lime. Many commend the same proportions now, but the sand may be increased to four of sand to one of lime without injuring the strength of the mortar. Mr. Banvard had made good work with a mortar having as high a proportion as twelve to one, but beyond that it could not be trusted.

ARCHITECTS' DESIGNS.—The City Council of Indianapolis will pay as follows for designs for the new City Hall, the cost of which is limited to $150,000: Four hundred ($400) for the first best plan, two hundred and fifty dollars ($250) for the second, and one hundred and fifty dollars ($150) for the third; and when built, should the city decide to build by such plan, the architect whose plans were accepted and received the first award, shall enter into a contract that his compensation shall not exceed three per cent. for all plans, details, specifications and supervising of the erection of said building, and from this amount shall be deducted four hundred dollars ($400) awarded as first premium when his plans were accepted. That three plans receiving the premiums shall be the property of the city and left in the care of the Market House and City Hall Commissioners.

ENGINEERING NEWS.

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JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.

S. D. V. BURR ASSOCIATE EDITOR.

SATURDAY, JAN. 14, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States, Canada and the Sandwich Islands, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICE OF MEETINGS.

The annual meeting of the Association of Civil Engineers and Surveyors of Michigan is in session this week at Lansing, Mich.

AMERICAN ASSOCIATION OF MECHANICAL ENGINEERS.—A regular meeting of this society is announced to be held in Philadelphia, beginning Wednesday, April 13. Members are requested to send their papers to the Secretary in ample time for reference to the Committee on Publication. There will be debate upon papers presented in 1881 before any new papers are read, and members wishing to discuss such papers are asked to study them before the meeting. The last meeting of the Council to pass upon application for membership will be at least 20 days before the meeting.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The annual meeting will be held in Washington, D. C., beginning Tuesday, Feb. 21, 1882. Members are requested to give early notice to the Secretary of their intention to read papers at this meeting.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The annual meeting will be held at the house of the Society, 127 East 23d street, New York, beginning Wednesday, Jan. 18, 1882, at 10 a. m.

The annual reports will be presented; officers of the society elected; proposed amendments to the constitution discussed. Reports are expected from the standing committees on gauging of streams, on tests of cement and on preservation of timber; also a report from the Board of Direction on the subject of tests of American iron, steel and other metals. These reports will be discussed.

Lunch will be served on Wednesday at the house of the Society. An evening session will be held if found desirable.

Thursday, Jan. 19.—Visits will be made to engineering works, among which will be the works of the Manhattan Gas Co., the Hudson River tunnel, the New York Steam Co., the New York and Brooklyn bridge. On the evening of Thursday there will be a reception and supper.

Details for the meeting, arranged by a special committee, will be announced at the opening reception.

Members intending to be present who have not already so notified the Secretary are requested to do so at once, that proper provision may be made for the full number.

JOHN BOGART, Secretary.

THE POLYTECHNIC ASSOCIATION.—Meets Thursday evenings from September to June, room 24, Cooper Union Building, New York City.

New inventions and miscellaneous subjects, 7.30 to 8.30; paper or address till 9; discussion thereon till 9.30.

EAST RIVER BRIDGE.

The completion of this important work is looked forward to as an event in American engineering; and the unaccountable delay which has prevented this completion, when it seemed all but on the point of achievement, has very naturally excited attention and elicited comments of all kinds—some, not complimentary to the engineers of the work, and others equally complimentary to the Board of Trustees, upon whom very properly rests the responsibility for the work. Is is known that a stated meeting of this board took place on Monday last (9th inst.), at which it was supposed, from the tenor of the discussions and resolutions adopted at the previous meeting, held Dec. 15, that important information would be forthcoming: and upon this supposition, the readers of ENGINEERING NEWS were requested to suspend their opinions for or against the management, in view of the new light which we had every reason to suppose, would be shed upon the past transactions, both of trustees and engineers. Hence, in accordance with our avowed mission of supplying engineering news, we are constrained to notice this meeting of the trustees, though, truth to say, the proceedings furnish no enlightenment on the causes of the delay in the work, nor as to *who* in the past had both the wisdom and audacity to so shape matters that the bridge when completed should not be a mere highway between two sections of the same city, but should as well become a factor towards the material progress of a—we were about to say—wide stretch of country, but will be better understood, if we say long stretch of country. Nor do we find in these same proceedings any definite statement as to when this most desirable consummation will be effected. It is true that in answer to a question by the Mayor of the city of Brooklyn, as to "*when* the Bridge would be completed," he was told by the President, "Next fall"; but this, under the circumstances, cannot be taken as a very definite answer, it being well known that so long ago as May, 1878, it was stated that "twelve months would be ample time within which to complete the structure," and we ourselves, with the best light attainable by an outsider, had accepted as satisfactory the statement, made some ten months since by one who was in a situation to *know*, that the bridge would be open for travel in this month of January, 1882!

It seems in the spring of 1878, when the Board of Trustees considered the early completion of the bridge as being then assured, a committee of the trustees was appointed to examine and report "upon the use to which the roadway of the bridge should be devoted." This was when the question of rapid transit in Brooklyn was under advisement by a commission appointed by the Mayor of the city, under the so-called rapid transit act, and it being understood then that, in view of the exposure of the cars to the effects of high winds, the chief engineer had been in favor of a gauge of track of six feet over the bridge, thus precluding the passage over the bridge of any motors or cars of the ordinary width of track in use in this section of country. The committee, very wisely, it is thought, reported decidedly in favor of the ordinary 4 ft. 8½-in. gauge of track, and gave their reasons therefor in full; but aside from using the expression, "that in the event of a 6-ft. width of track being adopted, no other cars than those in use by the Bridge Co. could be taken across," they do not refer in any way to the kind of traffic to be anticipated, but close their report in the following words: "The question of the use of the roadway will still be open and largely under the control of the trustees," and offered the following resolutions, which were adopted:

Resolved, That the gauge of the railroad designed for railway transit should be fixed at 4 ft. 8½ in.

Resolved, That it be held practicable to transfer (transport or carry over) the kind of car known as the Palace or sleeping car upon the bridge under the conditions already stated, and so that the stress of the car may be distributed over two or more beams; provided that no train should consist of a greater number of cars than three."

The adoption of these resolutions justified (in their own minds), some individual or individuals members of the Board of Trustees, of course, in authorizing the engineer to make such change in the height of trusses as would permit such passage of these cars, although it would appear that no direct vote to that effect was taken by the Board. This change necessitated an increase in the weight of superstructure, and when it was found that a largely increased cost of the bridge was, or would be, the result, no one has been found to accept the responsibility of having authorized it; but the measure was a wise one, although reached in an irregular manner, and as the change has been virtually effected, and the strength of the cables is sufficient, as the engineer expresses it, "to pull up the anchorages," the trustees, if wise, will abandon the attempt to find out *who* authorized the change of plan, and devote themselves to the completion of the work—a matter of far more importance to the public. But measures to this end formed no part of their deliberations. The engineer, in a detailed statement, having shown that precisely 1,064 tons more of steel was required, instead of the 1,200 tons previously supposed, one of the trustees offered a resolution, which was carried, "That the Chief Engineer be asked to inform the Board how the reduction of 136 tons from the 1,200 extra tons called for was made?" One would suppose, that after all the vexatious wrangle growing out of an increased quantity of material being called for, the fact that a less amount would suffice might be somewhat satisfactory, but it would seem not to be so. The Board adjourned at this stage of the proceedings, and we must wait a few weeks before the anxious public can know why 136 tons more of steel is *not* wanted, and after that important piece of information is made public—if, in the meantime the engineer should not have succeeded in economizing a few more tons of steel, which would call for another detailed report, this Board of Trustees might recollect, possibly, that there is something of more importance just now to the public; and that is, to show that the committee have grossly mismanaged the work committed to their trust.

That there has been mismanagement is too evident: not in the sense that money has been squandered, or that any individual connected with the management has profited in any manner by this long delay to complete the superstructure. No one supposes this; the character of the individual members comprising the management forbids the supposition. But that the Board of Trustees entered into contract for the material of the superstructure, without proper guarantees for its fulfillment, is too apparent to admit of question. Whatever may be the causes of the delay to complete the superstructure, in the difficulties attending the production of novel shapes of a comparatively new material, if they did not admit of close estimation, there should have been such judgment shown as to have provided for this contingency in the framing of the contract for the material of the superstructure. The public have not been advised of the cause of delay which has added over a twelvemonth at least to the opening of the bridge for travel, and it is evident that whatever may have been the cause, it is still potent in rendering it, in a measure, very doubtful when this day will arrive.

The public were led to expect that the bridge would be completed by the 4th of July, 1881, at the farthest. Now the President says "that if no financial complication arises it will be completed by next fall!" Setting aside all unprofitable inquiry as to who did this or that, the young Mayor of Brooklyn showed his practical common sense as follows: Mayor Low said he had a question or two which he would like to ask. The history of the bridge was interesting and important, *but the steps to be taken for its rapid completion were of more importance and interest to the city.* He would like to know if 1,000 tons or a little more would be enough to complete the work.

Mr. Barnes again explained the matter of the quantity needed. The engineers said now that 1,064 tons would be sufficient. The price was 8½ cents per pound.

Mayor Low—Do the engineers commit their professional reputations to the statement that the amount called for will be sufficient to complete the work?

Mr. Murphy—I so understand it.

Mayor Low—When will this amount be delivered?

Mr. Murphy—Probably by May next, if no financial complication arises.

Mayor Low—If the money question is not in issue, when will the structure be completed?

Mr. Murphy—If the money question is not in the way, the bridge will be completed by next fall.

Mayor Low—Is the money question in the way?

Mr. Murphy—We shall need about $600,000 more to complete the work and to put in the improvements in the way of facilities for transportation and traffic which are deemed advisable.

Mayor Low said he thought a report should be made of the amount needed, what it is needed for, the time when the work would be completed, and the contingencies which were to be expected.

Mr. Murphy asked if he wished to put the matter in the form of a motion.

Mayor Low said he did not, but only desired to make the suggestion.

It does not appear by the report of proceedings that this suggestion was embodied in any resolution of the Board; it was far too practical to admit of their immediate appreciation of its importance, and the Board adjourned without further action in the premises.

We append, as a matter of interest, the report of the Chief Engineer read at this meeting:

BROOKLYN, Jan. 9, 1882.

Hon. Henry C. Murphy, President Board of Trustees New York and Brooklyn Bridge:

DEAR SIR: I beg to submit the following in reply to

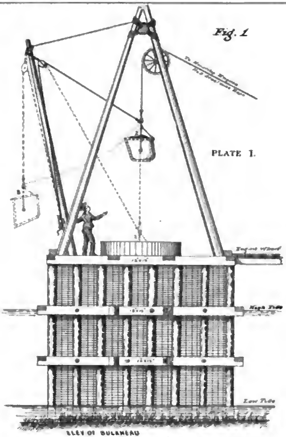
PLATE I.

SHAFT SINKING UNDER
DORCHESTER BA
BOSTON, M

By D. McN. S

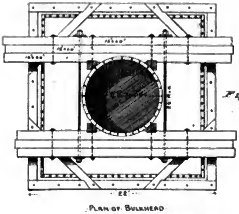
Member A. S. C

Fig. 1



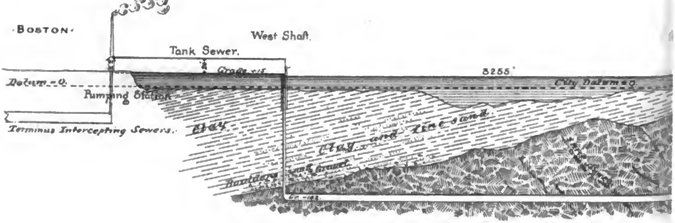
ELEV OF BULKHEAD
SHOWING 'OUT-HAUL' FOR DUMPING MATERIAL
BEFORE CAGE WAS PUT IN.

Fig. 2.



PLAN OF BULKHEAD
SHOWING CYLINDER CLAMPS

SCALE OF FEET

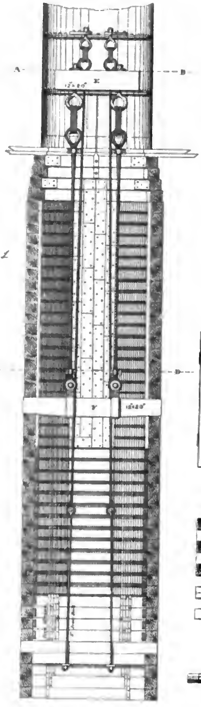


DIFFICULTIES AT
Y TUNNEL,
ASS.

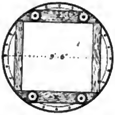
AUFFER,
E.

PLATE II.

Fig. 1

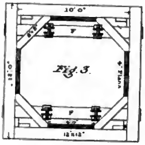


Vert Section of Shaft.



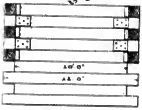
Section on A.B.

Fig. 2.



Section on C.D.

Fig. 4

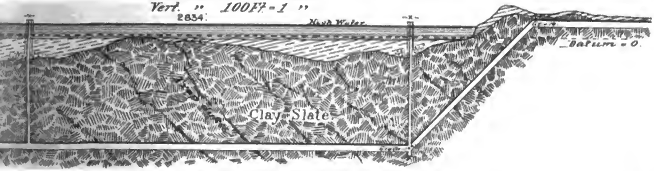


Shaft framing.

Scale of feet.

Profile Dorchester Bay Tunnel.

Hor. Scale. 600 Ft = 1 inch
Vert. " 100 Ft = 1 "



the resolutions passed by the Board of Trustees at the meeting held Dec. 12, 1881:

The aggregate strength of the wire composing each of the four cables has been estimated to be 12,840 tons (of 2,000 lbs.), and the elastic limit two-thirds of that amount, namely, 8,200 tons.

These estimates have been based upon the following data: An average has been made of the results of a large number of the tests of the pieces cut from the ends of each wire of which the cables were made.

This averaging embraced about one-third of all the wire in the cables, and when applied to the full amount in each cable gave the result above stated.

Most of the tests were made very soon after the wire was drawn and galvanized. Subsequent tests showed that the wire gained in strength by lying, at least, while these tests also showed that the wire was most likely to show inferiority at the ends, where, of course, all of the ordinary tests were made.

These facts seemed to justify the assumption that the average strength of all the wire was not placed too high.

Numerous tests showed the limit of elasticity to be never less than two-thirds of the ultimate strength and usually considerably more, while that which had the highest limit of elasticity usually had the higher modulus. Thus it will appear that the very lowest probable elastic strength of the cables has been stated, at which not a single wire coming within the requirements will be likely to have exceeded its elastic limit.

The method of splicing the wires was such that the full strength of the wire was maintained at all the joints.

The regulating of the wires and strands was so accurately done as to show almost exact parallelism when finally brought together in the cable.

The wires varied considerably in size, hence each piece tested was carefully measured and its area of cross-section obtained.

	Lbs.	
Amount of wire in cables	6,928,340	
Amount of wire in one cable	1,732,085	
Solid section of each cable	144,814-	1,000
At 170,000 per square foot	24,971.780	

STRENGTH OF SUPERSTRUCTURE.

The superstructure consists essentially of the floor system and stiffening trusses.

THE STRENGTH OF THE FLOOR BEAMS.

For the strength of the floor beams and the concentrated transitory load it is designed to sustain, I would refer to the sketch appended hereto.

The trusses have been so proportioned that when one-half the bridge is loaded it would deflect 10 in. at a point 400 ft. out from the tower, whereas without trusses and stays the cables alone would deflect 8 ft. at that point under the same load.

One of the most serious difficulties to be contended with in this structure is the maintenance of the balance of spans, arising from the exceptional length of the land spans. One of the early designs of this bridge contemplated the anchoring down the land cables half way between the towers and the main anchorage. This would apply to the case when the main span was loaded and the land spans empty. The reverse case when the main span was empty and the land span loaded could evidently not be provided for by those means. A closer examination also showed that after making proper allowances for temperature, stretch and rise and fall of land cables, such a provision would not be as effective as might be supposed at first sight. In most suspension bridges with short land spans the saddle movements are soon checked by the rapidly incurring tensions in the land cables as their curve becomes straightened. With our very long land cables other means must be added to check excessive saddle motion. There are three in number: Friction of saddle rollers, resistance and support of the truss and action of the stays.

The friction of the rollers under the saddles is as yet quite small, and the sensitiveness of the saddles due to the unequal loading of one or the other spans, has, during the erection of the superstructure been quite marked. The friction will increase with the load and with time, and I believe the saddle movement in the completed work under the ordinary traffic will be very small indeed.

The trusses counteract chiefly by the resistance they offer to being bent upward and also by relieving the cable of a part of its load, because they are continuous through the towers.

The stays, however, afford the most effective means of checking saddle motion. They act in a double capacity. As soon as a saddle movement causes the cable to fall it transfers a portion of its load to the stays, which extend out three hundred and fifty (350) feet, while on the other side of the tower the whole load which the stays carried is transferred to the cables, thereby increasing their counter tension on that side.

I am aware that the stays do not act in perfect harmony with the cables in cases of extreme temperature, and for a single span I should not be disposed to advocate their use, yet in our case I consider them indispensable. We need all the support they will give, and when the cable is depressed under a full load they will always come into bearing at a time when we want them most. The above-mentioned want of harmony between stays and cables is less in reality than in theory, because in a curve of equilibrium it takes a very small increase or diminution of load to lower or raise it in the quarters sufficient to bring the other system into action.

The weight of the suspended superstructure, when completed and ready for use, together with the transitory or live load, is shown in the following tabular statement. With these weights was calculated the margin of safety in the cables, mentioned in my last report. The statement also shows what proportion is carried by the cables and how much by the stays and trusses.

TABULAR STATEMENT OF WEIGHT OF SUSPENDED SUPERSTRUCTURE AND TRANSIENT LOAD.

	Total weight of bridge, anchorage to anchorage, 3,480 feet—tons.	Weight of main span between the first suspenders, 1,543 feet—tons.	Weight of main span carried by the cables and long stays between suspenders 18 and 18, 1,297 feet—tons.	Weight carried by the trusses and short stays between 1st and 18th suspenders, 246 feet—tons.
Suspended superstructure	6,620	3,050	2,340	710
Suspenders, wrought and cast-iron cable bands, over and under floor stays, wire netting and railing, propelling rope and supporting sheaves, grate bars, cable cross connections, etc.	1,180	500	500	....
Cables	3,460	1,660	1,580	....
Timber flooring	2,700	1,230	1,030	200
Steel rails, tramway guard rails and other iron in floor	600	300	250	50
Total permanent weight of bridge	14,680	6,740	5,700	960
Transitory load	3,100	1,380	1,100	220
Total weight of bridge, including transitory load	17,780	8,120	6,800	1,180

A change as important as the raising of a truss is not made at random on the spur of the moment. It is the result of a process of thought extending over weeks and months, and requires a more extended explanation.

It being the wish of the Board, as shown by the resolution annexed to the report of the committee, of which Mr. Kinsella was chairman, on the 6th of May, 1878, that the bridge should be adequate to the passage of a Pullman car, it became incumbent upon me to provide the necessary truss power, with which to transfer the concentrated loads, and to check the increased deformation of the cables resulting therefrom. Now, to increase the strength of the truss, we either have to increase the dimensions of all its parts, or else raise the truss and keep its dimensions about the same. The outer trusses could not have been raised, because it would have been necessary to strengthen the top chords by heavy and unsightly cross bracing extending over the whole roadway. They were therefore left at their original height, with a slight addition to their weight. I am aware that, theoretically, all the trusses should have been of the same height, but these outer ones are located at the extreme ends of the floor beams, far away from the other trusses and from the location of the concentrated loads, so that by a slight flexure of the floor beams they will be able to act sufficiently in harmony with the other trusses.

With the four middle trusses the case was different. They were close together and had to take care of heavier and more concentrated loads. In the plan, as it stood from 1869 to 1878, the promenade truss was raised 1 ft. higher than the intermediate truss next to it. The object of this was to serve as a railing to the promenade. For the two trusses to act together they must be of the same height. This could be attained either by lowering the promenade truss or raising the intermediate truss. To have lowered the promenade truss would have weakened it, which was not what we wanted. I therefore raised the intermediate truss to the height of the other and put in a cross connection on top to steady the top cord. An examination was made at the same time to see what increase of weight this would involve. It was found that, on paper at least, it would amount to very little, because the extra weight of post could be balanced by a slight decrease in the section of cords and tension bars. In actual execution, however, one hundred tons were added to each.

This plan remained in this state for several months. It afforded ample head room for the small elevated railroad cars and their locomotives, but it was evident that if the cars of other railroads, including Pullman cars, should ever apply for transit across the bridge they could not be accommodated.

Of course, I objected earnestly for two reasons: One because I could not see any probability of the passage of the largest size of railroad cars, and the other because it was my duty to protect the structure against every ton of additional weight not absolutely necessary. When I consented to make this change it was not so much owing to personal solicitation as to the reflection "of what benefit has it been to erect this bridge at a vast expense, unless we use it for every possible purpose to which the structure will lend itself?"

It is great mistake to suppose the trusses are too heavy for the rest of the work. At least 500 tons more material would be required in the trusses of the main span to make them as strong as the rest of the floor system. Weight has been added to the whole structure, and not to the trusses alone.

Owing to the great strength of the cables the margin of safety is a very rigid figure. It takes several hundred tons to move it up or down perceptibly. Hence it is that an inch off the planking or a shaving here and there has so slight an effect on the margin of safety, and therein lies our greatest security. To illustrate this point let me state that if the entire moving load of 1,750 tons were doubled the margin would only be reduced from 4 to 3½, and if, on the other hand, 1,000 tons could be taken off the dead load of the main span the margin would only rise from 4 to 4½.

In order to illustrate how wholesale and radical any reduction of weight must be to affect the cables appreciably, I will merely mention three possible cases, although I do not advocate any of them.

If the elevated promenade were abandoned and the foot travel thrown on the roadways below them, each middle cable would be relieved of 400 tons of strain, or of 13 per cent. of their total strain, and their margin would rise half a point.

Or if the intermediate trusses could be omitted (except their bottom cords) each of the four cables would be relieved of 180 tons of strain or six per cent. of their total strain.

Or again, if the four middle trusses could be cut down to the height of the outer ones 106 tons of strain would be taken off each of the four cables, provided it were equally distributed, or 260 tons off each middle cable, or seven and one-half per cent. of total strain.

The cables are strong enough to pull up the anchorages. Very respectfully yours,

W. A. ROEBLING, Chief Engineer.

It was moved that the report be printed and copies sent to the members of the Board, and that it lie over until next meeting, when it should be brought up for discussion.

PERSONAL.

D. W. C. ROWLAND, the present General Superintendent of the Tennessee & Nashville Railroad Company, was born in Hartford, Conn., July 1, 1829. He began his railroad career in June, 1851, as a baggageman on the Mobile & Ohio Railroad, rapidly advancing to the position of passenger conductor, and thence to that of Master of Transportation. He was Assistant Superintendent of Military Roads during the war, and in 1864 and 1865 was General Superintendent of Adams Express Army Freight Line, at Louisville, Ky., until Nov. 1 of the latter year, when he accepted the office of Assistant Superintendent of the Louisville & Nashville Railroad. The road, at that time, main stem and branches, was about 300 miles in length, and just emerging from a four years' war, was in a state of disorganization, without system or discipline. But Mr. Rowland went to work and ably assisted Colonel Fink in reorganizing and systematizing the road, and for ten years, up to October, 1875, was the chief assistant of Colonel Fink, who cheerfully awards to Mr. Rowland great credit for the excellent system and discipline of the transportation department, as adopted by the Louisville & Nashville Railroad. During this period, the road had been increased in length from 300 miles in 1865, to 900 in 1875. Yet the supervision and direction of organizing and operating the transportation department were personally directed by Mr. Rowland, and twice during Mr. Fink's term of ten years Mr. Rowland was promoted, first to the position of Superintendent, and next, in 1872, to that of Assistant General Superintendent. The latter position he held up to October, 1875, when Col. Fink resigned, and Hon. E. D. Standiford was elected President, and who immediately appointed Mr. Rowland General Superintendent of Transportation, of which position he had full control and discharged the duties of, throughout the whole term of Dr. Standiford's administration.

In October, 1879, the organization was changed and Col. F. de Funiak was made General Manager, who also re-appointed Mr. Rowland to the position he had so ably filled. Within the past two years the road has been extended by lease and purchase to 1,840 miles, more than double its length of 900 miles in 1875, and six times its length in 1865; yet Mr. Rowland has grown steadily up with it, and has personally reorganized and systematized all the new acquisitions to the road in the transportation department, besides directing the general working of the same, and bringing them one and the same uniform rules alike on all portions of the system.

GEO. F. BREYMANN, of the firm of Thacher & Breymann, submarine divers and contractors, Toledo, O., was in the city this week. Mr. Breymann has been full of business during the past season, being chiefly employed in submarine work in water-works construction and in bridge foundations.

A. GOTTLIEB, President and Chief Engineer of the Keystone Bridge Company, Pittsburgh, was in the city this week on business connected with his company.

MR. A. R. TREW has been appointed Chief Engineer of the Canada Southern Railway.

MR. W. M. DALY has been appointed Chief Engineer of the Cincinnati, Selma & Mobile Railroad.

MR. B. F. HANCOX is Chief Engineer of the Massachusetts Central, with head-quarters in Boston.

MR. D. W. LUM has been appointed Engineer-in-charge of maintenance of ways and buildings of the Lexington division of the Chesapeake & Ohio Railroad.

MR. CASIMIR CONSTABLE, member A. S. C. E., was married on the 11th to Miss Jennie Constable, daughter of Mr. William Constable, President of the Union Club, N. Y. City, at his residence in West Forty-eighth street. Rev. W. N. McVickar, of Philadelphia, assisted by the Rev. Dr. Robert S. Howland, rector of St. Bartholomew's, performed the ceremony.

D. W. CUNNINGHAM, Member A. S. C. E., formerly Assistant Engineer Boston Additional Water Supply, and more recently engineer for a system of sewerage of the city of Stillwater, Minn., has been appointed Engineer of the Water Board, Minneapolis, Minn., with headquarters in Room No. 1, City Hall.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 6.)

CLXXIV—KEOKUK.

Keokuk, Iowa, in lat. 40° 25′ N., long. 14° 26′ W., is on the Mississippi River at the foot of the Des Moines rapids, which are 12 miles long, in which distance the river falls 24 ft. The town, which was founded in 1840, is on limestone bluffs 130 ft. above the river.

In 1877–8 water-works were built by a private corporation, after the plans of W. C. Stripe, C. E., taking the supply from the river and pumping directly into the mains by a Holly 4-cylinder steam engine with cylinders of 14½-in. diameter and pumps of 8-in. diameter, all of 22-in. stroke. There is also a Worthington compound engine of 1,500,000 gallons daily capacity.

The water is taken from mid-channel in the river and conveyed through a 20-in. cast-iron pipe to a filter 50 by 15 ft., built of brick laid in cement. The bottom is 6 ft. below low-water level. Four feet above the bottom is a floor of timber joists laid on edge and ¼ in. apart, on which is laid broken stone, charcoal, coarse and fine sand, to a depth of 2½ ft. The filter is fairly effective. The water is aerated in passing down the rapids, and surface drainage from the opposite bank of the river is intercepted by a canal built by the U. S. government on that side.

Distribution is by cast-iron pipe, of which 11⅛ miles are in use, of from 20 to 4-in. diameter, 4,500 ft. being less than 6 in. There are 76 fire hydrants and 5 fountains, for each of which the city pays $100 per year. There are 450 taps.

The population in 1880 was 12,117, and the daily consumption is 550,000 gallons.

The ordinary pressure maintained at the pumps is 90 lbs. per square inches, which gives 35 lbs. in the highest part of the city. The fire pressure is sometimes 190 lbs. at the pumps.

The cost of the works has been $102,000. No returns are given of revenue and cost of maintenance. W. C. Stripe has been the engineer and manager of the works since their beginning.

CLXXV, OMAHA.

Omaha, Nebraska, in lat. 41° 15′ N., long. 95° 5′ W., is on the west bank of the Missouri River on three terraces, the first a few feet above high-water mark, and from 700 to 1,000 ft. wide; the second from 17 to 70 ft. above high water, and from 1,000 to 7,000 ft. wide, and the third of undulating surface, rising in places to 250 ft. above high water. The town was founded in 1855.

Water-works were built by a private company in 1880–81 after the plans of J. D. Cook, C. E., Chester B. Davis, C. E., being chief engineer of construction.

The supply is taken from the Missouri River more than a mile above the main outfall sewer of the city, and is first lifted by steam pumps into three settling basins, of slightly different dimensions, but averaging 325 by 125 ft. and 10 ft. deep, with inside slopes of 2 to 1, lined with brick laid in cement. They are used alternately. The time required for deposition of the sediment varies from 10 hours to 40 hours.

From them the water passes to the clear-water basin, 430 by 45 ft. and 10 ft. deep, whence it is lifted 280 ft. by two Knowles pumps to a reservoir 2 miles N. W. of the city, built in excavation and embankment, with two divisions, each 190 by 240 at water surface and 24 ft. deep, lined with 1 ft. of clay puddle, covered on the slopes with brick laid dry on edge, and on the bottom with 6 in. of broken stone.

The main engine is a compound-condensing Knowles pumping-engine, with steam cylinders of 33 and 60-in. and pump of 24-in. diameter, all of 42-in. stroke. The auxiliary engine is a high-pressure one, with 38-in. steam and 19-in. water cylinder, of 36-in. stroke.

The pumping main to the reservoir is of 16-in. diameter for a portion of the distance, then enlarged to 20 in. and again to 24 in. It serves also as the supply main from the reservoir.

Distribution is by cast-iron pipe, of from 18 to 4-in. diameter; 32 miles are laid, with 255 fire hydrants, 248 gates and 700 taps.

The works first went into operation in September, 1881, and the daily consumption is now about 350,000 gallons. The population in 1880 was 30,518.

The capital stock of the company is $600,000. The works have cost $400,000.

Nathan Shelton is Secretary and Treasurer of the company.

The receipt of statistics as follows is acknowledged with thanks: From Chester B. Davis, Chief Engineer, statistics of Omaha (Neb.) water-works. From D. Feller, Superintendent, reports of Water Commissioners of Binghamton, N. Y., for years 1876, 1878, 1879, 1880. From John Whitelaw, Chief Engineer, 25th report of Cleveland water-works for Dec. 31, 1880. From W. C. Stripe, Chief Engineer and Superintendent, statistics and water rates of Keokuk (Iowa) water-works.

◆

CORRESPONDENCE.

LAKE SUPERIOR ENGINEERING.

To ENGINEERING NEWS:

Assistant (admiring a one foot grade on a profile after running through a ravine): Mr. ——, that is a very nice grade and better than I expected could be gotten.

Chief: Oh, well, that is hardly enough to push the cars along; make it two feet to the hundred.

Assistant: All right.

Yours truly,

[Communicated.] R.

THE STANDARD METRIC CHAIN.

OFFICE OF THE MEXICAN CENTRAL RAILWAY,
GUANAJUATO, Mexico, Dec. 23, 1881.

EDITOR ENGINEERING NEWS:

Quite a diversity of opinion exists among some engineering acquaintances of mine as to what should be the standard length of a metric chain. Some claim it should be 20 meters, and others insist on 25 meters. Now this is a matter of importance, especially since the metric system is making such headway in civilized countries.

Some length ought to be adopted in order that one uniform series of tables could be calculated, to be used invariably hereafter as the metric standard. I would suggest that parties interested in this matter give their relative views through the columns of your valuable paper, or it might be advisable to appoint a committee of three or five persons to report on this subject, and I take the liberty of mentioning the name of Mr. Frederick Brooks, C. E., as one of them.

Yours respectfully, EMILE LOW.

WHAT IS GRADING?

PITTSBURGH, Pa., Jan. 8, 1882.

EDITOR ENGINEERING NEWS:

You ask for opinions upon the technical meaning of the word grading. The geological term degradation and the engineering term graduation or grading have the same derivation and nearly the same meaning. The first is the natural and accidental excavation of earth and rock from higher levels with the corresponding filling up of lower levels; the second is the same operation performed artificially and in pursuance of a plan. The first, however, has only reference to the lowering from a higher level, which is determined by the prefix de. If there was such a word as aggrade it could be applied to the filling up of the lower level. But when neither prefix is used the word expresses both operations, and means the modification of the natural surface of the ground so as to coincide with some established grade, either level or inclined.

Although the building of culverts and protection walls or abutments and piers are necessary for the preservation of the works of grading, or substitutes for it in connection with arches and trusses where grading would be impracticable, such structures are not logically a part of the work of grading any more than are the iron rails which are necessary to form the upper surface of the road where it would be impracticable to use the materials of grading. The whole of grading is accomplished by the de-gradation of the hill and by the deposit of the materials of de-gradation in the valley; the same as is expressed by the two French words *deblai* and *remblai*.

The Baltimore & Ohio Railroad is the oldest in the United States, and their methods and practice in construction have been followed by nearly all the others. If you will refer to their earliest and latest records you will see that in all their advertisements for proposals and specifications for contracts three distinct divisions were constantly observed, namely, graduation, masonry and bridging, and contracts have been repeatedly made with one man for the graduation or grading, and with another for the masonry on the same section of the road. MASTER MECHANIC.

WHAT IS GRADING.

N. P. R. R. Co., Rocky Mountain Division,
HELENA, Mont., Jan. 2, 1882.

EDITOR ENGINEERING NEWS:

In reference to the question "What is Grading" I would suggest that in an experience of over 35 years I have seen and heard the word "grading" used by engineers and contractors almost, if not quite, invariably in contra-distinction from masonry and bridging.

All blanks prepared for making estimates make the above distinction. Railroad accounts do the same. All reports of the cost of railroads continue the above distinction, yet when non-professional persons attempt to speak of such matters it is not uncommon to see the word used in such a way as to indicate an intention to have it cover the entire construction of a road ready for the superstructure. The general railroad law of Montana makes it obligatory upon railroad companies organized thereunder to grade ten miles each year, as a condition of corporate existence. If a railroad company, which had simply "graded" ten miles of road without constructing culverts or bridges, should be attacked in court for forfeiture of charter, I should expect the higher courts to hold that the law had been complied with; but should some city agree to issue its bonds when the same railroad company had graded ten miles of its road, I should expect one-half of all the lawyers and more than one-half of all the inferior courts to claim that grading included bridging and masonry, because they could not be made to understand that those whose business it is to use that word most, use it invariably in an exact sense.

Grading is, no doubt, the principal operation in constructing most railroads, but it should not, therefore, be held to include all other operations.

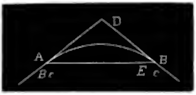
D.

ALIGNMENT OF COMPLETED RAILROADS.

PITTSFORD, N. Y., Dec. 26, 1881.

EDITOR ENGINEERING NEWS:

The questions of F. Miller in last week's issue appears to be very simple and easy to be answered. I do not know why it is any more difficult to determine the alignment of a road after it it built than to determine it before it is built. The tangents will show for themselves after it is built, and it appears that the only difficulty lies in locating the Bes and Ees. After running the curve line joining two tangents the whole amount of curvature in that curve will be known, and the length of chord joining the two ends of the curve and also the angles made by the chord tangent at each end. And if the angles at each end of the chord are not equal, the beginning and end of the curve is located wrong, and must be corrected. Let D = deflection at the intersections of tangents, then the distance from (Be) beginning of curve to intersection will = rad. tang. ½ D.



In running the curve we assume that A is Be and B is Ec, which are unequal distances from D.

Distance $DA = \frac{AC \sin. B}{\sin. D}$ $DB = \frac{AB \sin. A}{\sin. D}$

The above equations show which way A and B must be moved to locate them at the beginning and end of the curve.

The second question: Multiply the deflection distance for 100 ft. by the square of the distance used and divide by 10,000. L. L. NICHOLS.

PROBLEM.—A freight car with an area of 100 sq. ft. front, loaded with 10 tons, including its own weight, starts down a grade of 34 ft. to the mile, in a straight line, everything in good working order. What speed will it attain to when its speed becomes uniform?

INACCESSIBLE DISTANCES.

FERRYSBURG, Ottawa Co., Mich., Dec. 27, 1881.

EDITOR ENGINEERING NEWS:

The scheme for the determination of distances and altitudes, as given by M. Kazimiski in your issue of the 10th inst. is well calculated, as you suggest, to draw out comment. It is a rare example of how far a person may go in a roundabout way to do a thing, instead of going directly at it.

It will be observed that the graduation which he proposes for his vertical arc is the reverse of that in our ordinary arcs—*i.e.*, he makes his tangent scale vary by *constant* increments, while his vertical arc varies by diminishing increments—these increments varying inversely as their corresponding secants; while in our instruments the tangent scale varies by *increasing* increments—the increase being directly as the corresponding secants—and our arcs vary by constant, or equal increments.

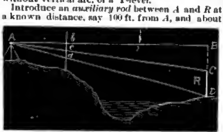
This change in the graduation of the arc appears to facilitate the measurement of horizontal distances, but is a total failure in the determination of heights or differences of level, if we regard simplicity and conciseness and amount of work (in volved as being factors in the consideration of the question; moreover, it spoils the arc for other purposes.

The fundamental principle underlying 'this method consists in the comparison of the differences of tangents—a method capable of development with the instrument already in use, with or without the use of a vertical arc—better without.

An example will best illustrate:

In the accompanying figure let it be required to find the horizontal distance between the station A and the rod R, our instruments being the usual leveling rods with tape and the engineer's transit without vertical arc, or a Y-level.

Introduce an *auxiliary rod* between A and R at a known distance, say 100 ft. from A, and about the thickness of the rod one side of the line between them, so that the horizontal wire of the telescope will cut both rods at one pointing.



Let the length between the two targets D and C on the rod R be assumed, an arbitrary constant, as large as practicable, say 12 ft.

Point the telescope at the upper target C of the rod R, and note the reading at c on the intermediate rod. Then train the telescope on the target D, and note the reading d on the intermediate rod.

The difference of the readings c and d gives us the intercept cd, which is the analogue of CD.

Then $CD \div cd = AB$ in terms of Ab,

for the triangles ABC and Abc are similar; as are also the triangles ABD and Abd, whence the differences CD and cd have the same ratio as the sides AB and Ab.

Numerically, let cd be found, say to equal .845 ft., then the rod D being 12 ft., and the horizontal distance Ab, being assumed at 100 ft.

$$AB = (12' \div .845') \times 100 = 1,420'.$$

If it is desired, also, to compute the differences of height between the "height of instrument" and the "height of hub," at rod R, we have only to note the *level* reading at b, on the intermediate rod, and multiplying the intercept bd thus found into the ratio of CD to cd already found.

Thus, supposing the intercept bd was found to be 2.126 ft., then

$$BD = (12' \div .845') \times 2.126' = 30.189'$$

which is subject to correction for refraction and curvature.

These operations are so simple and obvious as to require little or no further explanation; moreover, there is a degree of precision resulting from the introduction of the "intermediate" rod that is entirely unapproachable with any method of measuring vertical angles with the small arcs the instrument makers give us on our field instruments; for thereby we virtually read the limb of an arc having a 100 ft. radius.

It may be said that we require another helper by this method. So we do. But we have relieved the transit-man from all reading and recording of vertical angles, and of all consideration of these data in the office, which is more than a compensation for this extra assistant; besides, as before remarked, we have introduced a degree of precision utterly unattainable by *any other method.*

H. C. PEARSONS,
U. S. Inspector of Steam Vessels.

AMERICAN BRIDGE BUILDING IN THE ANTIPODES.

The Edgemoor Iron Company, of Wilmington, Del., have just completed the Nowra Bridge, over the Shoalhaven River, New South Wales, and the bridge has been thrown open to public traffic. Mr. Onward Bates was the engineer in charge of construction. The bridge is the longest in New South Wales, its length being 1,108 ft., width 20 ft. and the heading about 22 ft. It is high level, having no opening for navigation but admitting of river steamers passing under easily. There are seven spans of 124 ft. 6 in. each; one span of 181 ft. 6 in.; and one of 50 ft., and with the exception of the timber planking the materials used are iron. In connection with the shortest spans, the iron cylinders upon which the structure rests are twelve in number and 5 ft. in diameter. In the long span the cylinders are four in number and 7 ft. in diameter. On the northern end there are ten cylinders 3 ft. 6 in. in diameter with stone abutments. The superstructure is of American design and is the first of the kind erected in the colony. Whipple trusses are used. It is for use now only as a highway bridge but is built to sustain railway traffic. Connected with it is a wooden bridge on stone piers over the Bomaderry Creek, of one 90-ft. span and two spans of 80 ft. This latter structure is connected with a wooden bridge of two 30-ft. spans on an embankment forming the approach to the creek. These also are built strongly enough to sustain railway traffic. The cost of the three structures is about $210,000.

NOTES.

EXCAVATORS AND DREDGERS IN PANAMA.

Contradictory accounts have been published from time to time of the machinery to be employed for the excavations in the Panama Canal works. The following description of them may be taken as an official one, having been published by the company itself. The excavator, designed by M. Couvreux, is in fact a dredging machine on dry land, with the necessary modifications to suit the different nature of its work. The excavator, however, cannot stand over its work like a floating dredger, and the endless chain with buckets is therefore placed at one side of it, and nearly horizontal, although some inclination is given to the chain according to the slope of the ground and nature of the soil. The buckets are then driven along the slope of the cutting, scooping out the earth or cutting it away like a succession of planes, and throwing it out on the other side of their round. The excavator can be placed either on the level from which the excavation is to be made, or—in case of a mass of earth to be removed—on the level down to which the soil is to be brought. In every case, it stands by the side of the place of work, upon rails of the normal gauge, and moves along continously while in action. After it has reached the end of the rails they have to be shifted, either to bring it again alongside of the remaining mass to be leveled, or to remove it further from the trench. The great weight of the chain of buckets, with all its apparatus, coming entirely upon one side, and the tremendous strain of the work, so unequally distributed, made the question of securing the balance of the machine a very difficult one. This has been effected by various expedients, of which the principal has been the use of a third wheel on each of the four axles, working on a third rail 20 in. within the outer rails on the side of the chain. The excavator is furnished with two engines; one of 20 horse-power drives the chain; the other, of only 4 horse-power, moves the machine on the rails. The appearance of the whole is like a very tall locomotive, and the total weight is somewhat over 44 tons. The buckets contain about 6 cu. ft. each, and their number varies according to circumstances. They can be driven to the depth of 16 ft. The excavator works at the rate of 80 turns per minute, and on an average (allowing for loss of time) excavates and loads on trucks 84,600 cu. ft. of earth per day, thus doing the work of fully 600 laborers. It only requires the services of a driver, stoker and two workmen for various purposes, besides the men who remove the rails, which only takes up a portion of their time. The dredging machines employed in this work are of great size and power; they are 110 ft. long by 21 ft. broad, and weigh when empty about 06¼ tons. The buckets contain about 10 cubic feet each; they can be driven nearly 30 ft. deep, and lift their contents to such a height that they can be shot to a distance of 183 ft. The average of work done is nearly as great as that of the excavator.

THE PANAMA CANAL.

A complete account has now been published of the proceedings of the superior consulting committee of the Panama Canal works, which assembled in Paris for its first session on November 25. A report drawn up by the consulting engineer, containing the proposals of the administrative council for the second phase of the work, was laid before the Commission, and served as the basis of its deliberations. It is considered that the best opening for the canal at its eastern end into the Bay of Simon will be by the way of the mouth of Folks' River. A cutting through the Mindi Hills would bring the canal from Folks' River to join the River Chagres, whose bed is also to be taken advantage of for a considerable distance; and it is proposed to begin it very soon, and make a sort of temporary canal for immediate use on the line of the great one, so as to establish water communication with Gatun, on the Chagres. The administration asked permission to begin work at once at two points; upon the rocks between the falls of the Obispo, and at the highest point of the cuttings, the top of the Cerro Culebra, where, however, the soil is argillaceous. Here preliminary cuttings will be made, which will give more accurate knowledge of the nature of the ground than can be derived from any number of soundings. According as the earth is removed, it will first be piled up in banks to protect the cuttings from becoming drains for rain water, and then gradually be used for a tramway from the Culebra working to the Gamboa dam to convey thither all the remaining débris. We have mentioned this dam before and now need only add that owing to the great depth at which the solid rock lies at that spot it has been decided not to attempt to make any foundation, but simply to heap the materials on the surface of the ground. A wall of great blocks of stone will cross the valley. Inside and above it will be laid in order small blocks, rough stones, pebbles, gravel, sand and clay, and the Culebra débris. Arrangements will be made to prevent flooding during the course of the work. The Commission assented (after deliberation) to these and all other proposals of the administration, with a few slight qualifications.

THE ADIRONDACK SURVEY.

Commendable progress has been made in the survey of the Adirondack region heretofore authorized by the Legislature. An important permanent basis for all leveling work in the northern counties has been made the past season, by the location of a line of geodetic levels, carried northward from Albany through two degrees of latitude, and forming, in connection with the United States surveys, a continuous line of reference levels with monuments from New York harbor to the Canadian frontier. Valuable work has also been accomplished under the direction of the superintendent of the Adirondack survey in relocating the boundary lines of Essex, Franklin, Hamilton, Herkimer and Lewis counties. Evidences of former surveys were generally extinct, and in one instance every vestige was obliterated for a distance of thirty-five miles. Township lines were also found to be in great confusion, rendering assessments for taxation difficult and causing much embarrassment in the collection of taxes. Provision should be properly made for the location and permanent marking of these obscure and missing lines, so as to avoid constantly recurring difficulties, both as to local jurisdiction and the ownership of adjacent lands. The reports of the Adirondack survey have been largely sought by the public, and in authorizing future publications it may be well for the Legislature to consider the practicability of having them placed on sale. It is not unlikely that the expense of publication would be partially if not wholly met by this means.

Pertinent to matters relating to the survey above referred to, is a subject suggestive of practical observation in regard to the northern wilderness. The vast tract of country lying in the northern part of the State, familiarly known as the Adirondack region, has become one of the most inviting resorts to invalids and tourists. Its high altitudes, pure and bracing atmosphere, perennial streams and mountain lakes, in the shade of primeval forests, constitute the desirable features of a retreat designed by nature for the uses of mankind in pursuit of health or pleasure. But there are other and grave interests belonging to this portion of our territory that appeal with especial force for timely consideration. By far the greater quantity of land within the Adirondack wilderness proper belongs to the State. Individual ownership is now confined to a few hundred thousand acres. Heretofore it has been the practice of the State, with questionable policy, to sell its wild lands at nominal prices to private parties, who have gone on in most cases, and cut off the marketable timber where accessible, and then abandoned to the State the clearings, worthless generally for agricultural purposes, thereby escaping the payment of taxes. Forest fires have followed and raged with destructive fury, denuding the mountains and checking the flow of springs and streams that supply the navigable waters to the north, and the Hudson River southward. Furthermore, many of the lakes, the natural reservoirs of the mountain courses, have been damaged by dams and overflow, so that the shores of those lying within the working timber limits present the effects of irreparable injury. It has, therefore, become a question of serious import whether the State should any longer part with its title to land in this quarter, now held or that may hereafter revert by the non-payment of taxes. It might be leased, perhaps, with safety, for certain purposes; but its uses should be carefully restricted.

The Adirondack region is the natural and principal water-shed of important navigable waters, and, if it be divested of its timber, imminent danger will threaten. The rain-falls will diminish, the springs and streams fail, and unaccountable loss ensue to interests not immediately located in that part of the State. This subject will, indeed, sooner or later demand inquiry, if its importance does not now compel investigation.—*Gov. Cornell's Message.*

GUNPOWDER.

The ingredients in gunpowder are saltpeter, charcoal and sulphur; slightly different proportions are employed in different countries; in the United States the proportions are 75 to 76 saltpeter, 14 to 15 charcoal and 10 sulphur. Charcoal is the combustible ingredient; saltpeter furnishes the oxygen necessary to support a rapid combustion and to change the whole mass into gas, and sulphur adds consistency to the mixture and intensity to the flame, besides rendering the powder less liable to absorb moisture, and increases the volume of gas by preventing the formation of a solid potassium carbonate and by increasing the temperature. In the manufacture of ordinary powder the operations usually employed are pulverizing the ingredients, incorporation, compression, granulation, glazing, drying and dusting. When Gheugis Kahn invaded China, B. C. 1219, firearms of a primitive form appear to have been used. Passages in old writers seem also to show that when Alexander invaded India, 327 B. C., he encountered tribes that used similar weapons. It is probable that the invention of powder arose in Central Asia, in the regions where saltpetre occurs as an efflorescence of the soil. The use of gunpowder is mentioned in Arabic writings in the 13th century, but its use in Europe can be traced only to the middle or early part of the 14th century. The powder used in the United States is principally "Hexagonal powder," and in the United States service five kinds of grain powder are used, all made in the same manner, of the same proportions of materials, and different only in the size of the grain, namely: "Mammoth," "cannon," "mortar," "musket" and "rifle" powder. There are other powders with trade names given them by the respective manufacturers. Powder for rifles is made with special reference to the attainment of a high initial velocity with a moderate press on the bore; it has a density of 1.80 and a size of grain which will pass through sieves of 16 meshes to the inch and lie on one 24 to the inch. In selecting powder take note that it should be uniform in color, density, size and shape of grain; difference of color indicates a difference in the inflammability of the charcoal used; difference in the shape of grain, that of density; the largest and smallest grains may with advantage be removed by sieves of proper sizes.

A CANAL BOAT PROPELLED BY AIR.

A novelty in canal boats has recently been constructed at Wiscasset, Me., after designs devised by the owner, who claims to hold patents for the design in the United States and England. The first boat built is lying at the mouth of Charles River, Boston, where it has been examined with much interest by engineers and others. It is designed to be used on canals without injuring the banks; it is a simple structure, measuring 62 ft. long and 20 ft. wide. It is 3 ft. in depth and draws 17 in. water. It is driven entirely by air, a Roots blower No. 4 being used; the latter operated by an 8 horse-power engine. The air is forced down a central shaft to the bottom, where it is deflected, and, being confined between keels, passes backward and upward, escaping at the stern through an orifice 19 ft. wide, so as to form a sort of air wedge between the boat and the surface of the water. The force with which the air strikes the water is what propels it. ,The boat has a speed of four miles an hour, but requires a 35 horse-power engine to develop its full capabilities. The patentee claims a great advantage in doing away with the heavy machinery of screws and side wheels, and believes that the contrivance gives full results in proportion to the power employed.

DISPOSING OF SEWAGE.

In the current number of *The Sanitarian* Dr. H. G. Beyer, United States Navy, describes the method of treating excreta with Suvern's deodorizer in one of the Leipzig hospitals. This deodorizer is a pasty mass with the following composition: In 100 parts there were water, 61.5; lime (CaO), 30.5; chloride of magnesia ($MgCl_2$), 1.5; tar, 1.2; foreign matter, 5.3. In manufacturing the deodorant, crude lime and magnesia being used, it is from this source that a great deal of foreign matter is introduced into it. A certain amount of the mass is dissolved in water and poured into the closets, where it is retained until the process of disinfection is completed. The resulting mixture is then allowed to run through the closet pipes into the drain pipes, and thence into a specially prepared reservoir where one part of it is precipitated, and the clear, supernatant liquid is then run off into the sewers. How thorough the action of this deodorant is, says Dr. Beyer, was seen by a specimen of the liquid taken out of the reservoir and reserved for analysis. This liquid was almost colorless, had only a faint smell of tar, and did not seem to decompose, even after long standing. It contained 0.353 parts of solid residue in one litre, consisting for the most part of chloride of ammonium and lime, and having an alkaline reaction. The precipitate is finally dried and carted away.

NEW YORK TENEMENTS.

The main outcome of the tenement house agitation, which attracted so much attention three years ago, was a legislative act that has proved a most wholesome remedial measure. During that period hundreds of tenement houses have been built, but there is not one in which there is a single room that does not have direct air and light. So effectual is this remedial agent that the sanitary officials are boasting that the tenement houses recently built are in advance of private residences in sanitary conditions. If the new plumbing act proves as useful in effecting thorough drainage as this building act has been in letting in air and light, the lodging places of the poor will be permanently improved. These are the new homes of the working people. The old tenement houses remain damp and foul, for the radical defects of construction are not affected by recent legislation. Progress has been made, however, in the right direction. Let the health of the lower classes be promoted, and good morals and useful citizenship follow as a matter of course.

* * *

MISCELLANEOUS.

ENGINEERING PERILS.—A detachment of the Second Cavalry from Fort Custer has been sent to Terry's Landing, on the Upper Yellowstone, to protect the Northern Pacific engineers and the construction company from the *marauding* Crows.

THE ADIRONDACK RAILROAD'S FUTURE.—Dr. Durant proposes to reorganize the Adirondack Railroad Company and complete the road to the St. Lawrence River. It has not been decided whether the road will strike the St. Lawrence at Ogdensburgh or at a point where Kingston can be reached, and a direct New York and New England connection made for the Grand Trunk from that point.

THE CERRO GORDO.—CHARLESTON, Ill., Dec. 24.—A full corps of engineers arrived here to-day, having completed the survey and final location of the Cerro Gordo Short-Line railroad from Marva, on the main line on the Illinois Central Railroad, to this city. They report that at no place is the grade more than fifteen feet. After the holidays they will proceed locating an extension to Louisville, Ky., the intention being to have a line from Peoria, Ill., and places beyond the former city in Kentucky.

LOCOMOTIVE BUILDING.—Five hundred locomotives have been built in the three Paterson establishments during the past year, worth upward of $5,000,000. The price ranges from $8,000 to $14,000, according to size and character. This is the largest number ever turned out in Paterson in any one year. The business has been conducted almost entirely on a cash basis. The prices obtained have been very much lower than in former years and the profits correspondingly less, but the losses have also been much below the average in consequence of the cash policy pursued. From present appearances, fully 600 locomotives will be completed in the same city next year.

A NEW BOSTON & CHICAGO R. R.—Engineers are surveying a route for a new railroad from Danby, Vt., by way of Tinmouth, Middletown, Poultney, Castleton, Fair Haven and Orwell, to a point on Lake Champlain, opposite Ticonderoga, where the lake will be bridged. The distance is fifty-five miles. Another road is contemplated from South Shaftsbury, Vt., by way of Bennington to the Hoosac Tunnel. These lines, with the Bennington & Rutland Railroad, would provide a new route from the tunnel to Ticonderoga. It is proposed to connect Ticonderoga by a road through the North Woods with Sackett's Harbor, and, by forming western connections with the Grand Trunk Railroad and eastern connections with the new Massachusetts Central Railroad at the tunnel, make a route from Chicago to Boston, 150 miles shorter than any now in existence.

A BIG RAILROAD BORE.—The tunnel of the Denver & South Park division of the Union Pacific Railway through the main range of the Rocky Mountains, at an elevation of 11,525 feet, has recently been completed. The length of the bore is 1,770 feet, the height 16½ feet, and the width 13 feet. It is arched and timbered with California redwood. Nearly 500,000 feet of this timber have been used in the construction of the tunnel. The cost of this wood, including the freight charges upon the Central Pacific, was from $80 to $110 per thousand feet. The formation through which this tunnel was cut is composed of slide-rock, bowlder, and decomposed granite. The amount of false timbering cost was not less than 1,500,000 feet. This was hauled over the mountain through over an average of seven feet of snow, and a few snow-banks from fifty to sixty feet in depth. Last winter the laborers had to sink a shaft thirty feet in depth, through packed and frozen snow, to reach their work. During violent storms the workmen, in going to and from their cabins, were obliged to move in gangs, to avoid being lost in the snow, and frequently their clothes were frozen to their skins. The contract cost of the tunnel was $275,000.

THE PENNSYLVANIA RAILROAD.—Mr. Slataper, Chief Engineer of the Pennsylvania Company's lines, was in Chicago recently. He says his whole attention is given to watching the movements of encroaching railway lines in the vicinity of Pittsburgh. The hillsides and valleys in that section are gridironed with embryo railroad routes. Land-holders on these projected lines are asking fabulous sums for rights-of-way. He says the Pittsburgh, Fort Wayne & Chicago Railroad Company are preparing to build two additional tracks from Pittsburgh outward for a distance of twelve or fifteen miles. This enlargement of track facilities is required to meet the increasing volume of business at that point. Mr. Slataper, speaking of the report started by an Indianapolis newspaper, and reproduced in many other sheets, foreshadowing important changes in the executive management of the Pennsylvania system of roads, said there was not the slightest probability that any such changes would occur. He said the present high officials are in perfect accord, and no one is scheming for the overthrow of anybody else. Mr. Slataper is here to settle with the city authorities for the company's share of the expense of building the Harrison street viaduct.

THE C. P. R. R. IN ENGLAND.—A pamphlet has just been published in London, entitled "The Canadian Pacific Railroad and the Schemes of the Syndicate," warning the English people not to invest their money in what is represented to be a reckless enterprise. "The Canadian Pacific," the pamphlet says, "takes its only course through the unpeopled valley of the Saskatchewan and the district called the Fertile Belt, but it can have no extensions northward, except the Arctic regions, and no branch in that direction except to the north pole, while southward it has its rival in the Northern Pacific of the United States. For six months the road will be an ice-bound, snow-covered route, through districts many hundreds of miles further removed from the great marts of the world, and from the cities and ports served by the railways which traverse in every direction the Golden Northwest and the granaries of the world. Over the whole of the territory through which the road is proposed to run, there is not, with the exception of Winnipeg, a single town, or city, or settlement of any importance. No intimation has yet been given of the existence of any deposit of the precious metals, or of other sources of mineral wealth, such as those on the line of the Union Pacific. The section of 650 miles between the proposed junction at Callender with the Canada Central & Thunder Bay is a perfect blank, even on the maps of Canada, and all that is known of this region is, that it would be impossible to construct this one section of the railway for the whole cash subsidy provided by the Canadian government for the entire scheme, including 2,750 miles at $25,000 per mile. The district north of Lake Superior may be regarded as wholly and absolutely unfitted for agricultural settlements or for railway construction or working."

RAILROAD CONSTRUCTION IN 1881.—We append a table showing the railroad construction of the country for 1881. The total number of miles constructed was 8,603, the largest of any year on record, making the total mileage for the whole United States and Territories at the close of 1881 102,274 miles. The remarkable increase in railroad building is the natural result of the prosperity of the past few years and the rapid development of country following the vast tide of immigration to the United States from all parts of the world. The sections of country which have profited most from the enormous sale of grain, cotton and hog products since 1878 have acquired the largest number of new railway lines during the year. Thus of the 8,603 miles of road built during 1881, 3,383 were in the Southwestern States, 2,298 in the Northwestern States, 1,231 in the Southern States, and 1,135¼ in the Pacific States. Of the 402¼ miles constructed in the Middle States 219 were in New York and 113 in Pennsylvania. It is hardly probable that the coming year will be as prolific of railroad enterprises as 1881, in view of the fact that excessive railroad building makes capital timid and that investors have already suffered losses by placing their money in roads which are being built in advance of the requirements of the sections traversed. In this respect the liquidations on the Stock Exchange will have a wholesome influence; in fact, they have already effectually stopped many wild schemes about to be launched upon the public. The following shows the railroad construction for the year 1881:

	Miles.
New England States	165
Middle States	402¼
Southern States	1,231
Northwestern States, etc	2,298
Southwestern States, etc	3,383
Pacific States	1,135¼
Total United States, etc	8,603

MISSOURI RIVER "IMPROVEMENTS."—A prominent business man from the upper Missouri, who wants his name withheld, for obvious reasons, upon being interviewed on the proposed appropriation for the improvement of the Big Muddy from Cow Island down, says: "I'm not opposed to its improvement. To have it made easily navigable during all the spring, summer and fall months, barring the cold parts, of course would mean a good many hundreds, I may say thousands, of dollars to me; but I tell you honestly that except for the good the money would do the working classes you might as well throw it into one of the sand boils on the treacherous stream. They talk of $10,000 per mile, and some of my friends wanted me to attend the convention at St. Joe as a delegate and help whoop-up the project. They might as well ask for $10,000 an inch while they are about it, for that wouldn't be enough. It hasn't banks, bottom, or direction. Every freshet makes a practically new river, and you can't fill the maw contained in a couple of rods of water by piling in all the stone you can haul. They put in ninety car loads in a short piece between Kansas City and St. Joe to secure a railway track, and one of the contractors told me you wouldn't know they had ever done a dollar's worth of work there. Not a stone is in sight, nor can one be felt by prodding under the water and mud. Wing dams and slough dams go out at the first rise, for there isn't any way of securing them. Those dams on the Yellowstone, although that isn't as bad a stream as the Missouri, will be gone next May. Now, above Cow Island the stream is different, and the work done by the Government engineers there amounts to something. It's a good and valuable job, and when they finish they will receive the thanks of steamboat men. But below, as I said, a child could see that money, no matter if it was spent like water, can avail nothing in the way of permanent good, and to appropriate it is all foolishness. The Yellowstone is different, and maybe something could be done with it. In my judgment the best way would be to build two dams across it. I first thought of this by seeing, when boating on the Yellowstone, ridges running straight across the stream and sometimes nearly two feet high. To one who didn't know it would appear like an obstruction, but there was always plenty of water on the natural dams which were made by a step, or terrace, in the bed of the river. If there were more of them I am inclined to believe navigation would be better."—*Chicago Times.*

THE SOUTH FERRY & SEASIDE DIRECT TRANSIT COMPANY.

This railway company was chartered last August under what is known as the Tunnel Bill, which was passed in 1880 and became a part of the General Railroad Law of this State, being similar to the Rapid Transit Act, with the exception that it does not require a petition of a certain number of citizens to have a commission appointed to determine whether the road should be built. An application for commissioners is made by the company only in case the consent of the owners of a majority of the valuation of the property along the line cannot be obtained. This company has already obtained more than two-thirds of the required amount of consents, and the remainder is promised on condition that the company give to each owner who signs, full paid stock to the amount for which his property was assessed and which was paid to the Long Island and Jamaica railway companies for closing up the old tunnel and for ceasing operations of their railway on Atlantic avenue, from South Ferry to the city line.*

The line of location proposed by this company is under Atlantic avenue from South Ferry to a point between Third and Fourth avenues; thence between these avenues through purchased private property to the city line and Fort Hamilton; thence probably turning eastwardly and passing through Bath, Sheepshead Bay and over Barren Island to Rockaway inlet, across the latter to Rockaway Beach, making a total distance of about 16½ miles. There will also probably be a branch to Coney Island.

It is the intention of the company to locate its South Ferry depot on the block bounded by Atlantic avenue, Columbia place, State and Hicks streets, giving them a length of 412 ft. of station in the open air. Passing under Hicks street, the railway will communicate with the old tunnel by a curve about 100 ft. east of Hicks street. The company will use the old tunnel from that point to about Court street, where they will have a second station, and from which they will commence their new structure. At some intermediate point between Court street and Third avenue there will be a third station. On Atlantic avenue, between Third and Fourth avenues, there will be a northerly curve to Flatbush avenue, at which point a fourth and central Brooklyn station will be located. This station will also be on private property and open, and will be connected in a direct line to Fort Hamilton. The stations along the remainder of the line to the latter point will be about one-half mile apart.

From the central station to Fort Hamilton the road will be at the same grade below all of the cross streets as on Atlantic avenue, and will be nearly entirely roofed in to Baltic street, at or about which street commences the Gowanus Flatlands, which are not at present filled in. Few of the cross streets are graded until Seventh street is reached. From this street to about Twenty-sixth street will require excavation through a moderately well built-up section. From Baltic street up to this latter point the streets will pass over the road on brick arches or iron beams arched in with brick, the road being open cut when it passes through the blocks.

The remainder of the line to Fort Hamilton intercepts but a few buildings, and from thence to the terminus is of easy surface construction.

The grades over the entire line are light. The track will have a 4 ft. 8½ in. gauge, and will be laid with heavy steel rails.

The formation of the tunnel portion of the line will be in two parallel subways, separated by a brick wall with openings at intervals for communication from one to the other. Each subway will be about 12 ft. wide and 14 ft. high in the clear above the grade of rail. There will be ventilating apertures leading from each side of the tunnel extending to the sidewalks, which will be properly inclosed to prevent trash from getting into them. The movements of the trains will draw in fresh and force out the foul air.

The entire outside surface of the tunnel, top, bottom and sides, will be coated with Lienmer asphalt, so that it will be entirely free from dampness within. The interior will be coated with cement, and the tunnels will be lighted with electricity.

It is the intention of the company, if it uses steam for this portion of the line, to adopt locomotives having the most recent improvements for consuming their own smoke and condensing the escaping steam. The cars will be of a type somewhat similar to those used on the Sixth Avenue Elevated roads in New York City, and the trains will consist of about six cars.

The second and third stations on Atlantic avenue will be of ample length and have platforms of 12 to 14 ft. in width, and the entrances to them will be from both sides of the street.

The surface of Atlantic avenue and the horse-car tracks will remain just the same as they are at present. The sewerage is but little interfered with by the structure, or during construction, as the longitudinal sewers of the avenue are considerably closer to the curbs than the outside walls of the tunnel. The bottom of the Smith street sewer crosses Atlantic avenue about 7½ ft. below the surface of the street, and the tunnel will pass under it, leaving the foundation of the tunnel still from 8 to 9 ft. above mean high water.

There will be but one cross sewer affected between Smith and Third avenue, and that will be depressed under the road and extended with a proper flow to a junction with the original sewer, this being easily done, because the grades of the cross streets fall rapidly towards the south. The entire work connected with the sewers and water-pipes will be made under the direction and to the satisfaction of the Chief Engineer of the Department of Public Works, the company being compelled by the law to meet all the expenses. Water and gas-pipes will be but little interfered with, and never in such a way as to affect a continuous supply.

The cost of construction of the road from South Ferry to Fort Hamilton is estimated to be in the neighborhood of two million dollars. The remainder of the line to Rockaway and Coney Island will cost about the same as the other railways to these points. However, this latter portion of the line is not at present determined on, as the line as far as Bay Ridge is so close to the existent railroads to the seaside that it will be a feeder to them. The close proximity at Third avenue to the Long Island Railroad will furnish traffic to the Brighton Beach, and the same may be said of Gunther's road at Greenwood, as well as Culver's road, which is but a few blocks to the east and directly connected by the street cars. At Bay Ridge the road will run over and above the Manhattan and Sea Beach roads, and will therefore form a close connection with these.

Thus the facilities for Brooklyn to reach the seashore will be materially increased, while the rapid-transit operations of the road from Fort Hamilton to South Ferry, with very frequent trains, is considered by the company to pay handsomely on the capital invested.

The fare at all hours within the city line will be five cents, and to Fort Hamilton an additional five cents, as is now charged by the steam dummies.

The company expects by thus facilitating the traffic to all parts of South Brooklyn, as well as to Prospect Park, to have its revenues continually on the increase, and that Atlantic avenue will reap the full benefit of this trade.

The company expects to get the consents within the next few weeks, and as soon as legal possession can be had of the avenue and the right of way on the remainder of it to the City Line, it will commence work promptly, and intends to complete it within 6 or 8 months thereafter.

It is understood that there are very strong financial men, and having railway experience, in the company, and that there will be no delay in executing the work.*

The officers of the company are Lewis M. Brown, President, at 48 Wall street, New York City; Wm. B. Schermerhorn, Secretary; William Redmond, Treasurer, and Walter J. Morris, Chief Engineer, whose office is at No. 162 Atlantic avenue, Brooklyn.

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RAPID TRACK-LAYING IN TEXAS.

HOW TWO MILES OF TRACK PER DIEM WAS LAID ACROSS THE STAKED-PLAINS IN TEXAS, ON THE TEXAS & PACIFIC RAILWAY.

[Written for ENGINEERING NEWS, by W. M. Johnson, Assistant-Engineer in charge of track.]

Statisticians say that there are 94,000 miles of main track and 22,000 miles of second and side tracks now in operation in the United States, and that annually about 300,000,000 people travel over the same.

Yet very few of this multitude know how track is laid on these many miles of railroad, and for their benefit, as well as for those who know somewhat of track-laying, I propose to tell how we laid two miles of track per diem across the staked-plains in Texas, on the Texas & Pacific Railway. Track-laying after a halt of two years was resumed at Ft. Worth on the 25th of March, 1880, and has † now been laid to a point 400 miles west, leaving yet 205 more to reach El Paso on the Rio Grande, which will be finished by Jan. 1, 1882.

The first 100 miles of this was laid in 190 days, at the average rate of 0.526 miles per diem; the second, in 159 days, or 0.629 miles per diem; the third, in 102 days, nearly one mile per day, and the fourth hundred miles in 67 days, or an average of 1½ miles per diem, and this is now increased to two miles per day, which will be maintained until the Rio Grande is reached at El Paso. The delays on the first, second and third divisions (100 miles each) was due to the lack of sufficient rolling-stock to handle the track material as fast as required, but this has now been provided.

Each day at 6 a. m. the superintendent of the track-laying force gives the signal, and the racket begins by the ringing of the engine bell, the two blasts of the steam-whistle, and a clambering and hastening of the men getting on the track-train. Soon after pulling out from the boarding-train for the end of track, the track-train is slowed up to allow different gangs to drop off at the unfinished work of yesterday.

First, the back-fillers, then the liners, then the back-spikers, and at last the tie-loaders jumping off, until at seven o'clock sharp the track-train, followed by the tie-train, is at the front, and all hands begin the day's work.

Standing under a friendly mesquite bush (thermometer 106° in the shade), and keeping one eye out for snakes, scorpions, centipedes and tarantulas, you may observe the course of the work as it passes to the west, and take note of the different features of the system as organized for this contract.

The first individual in the procession is the panel-spacer, with a pick and a 30-ft. wooden pole, who marks on the road-bed each length of 30 ft. (this being the length of the rail used), to guide the tie-wrestlers in dropping 15 ties to each panel.

Next comes the road-maker, with pick and shovel, who moves away obstacles in the way of the tie-wagons, and makes a run-way for them up the sides of high embankments where the haul is too long to reach the end.

Then come the tie-wagons, each hauling 12 oak ties per load, and averaging 10 loads per day, requiring 44 wagons to haul 5,280 ties, or enough for two miles of track per day.

These wagons are driven across the road-bed and unloaded so as to leave 15 ties to each panel of 30 ft. These oak ties are 6 in. thick, 10 in. wide, and 8 ft. long, weighing about 200 lbs. each, making 2,400 lbs. per wagon-load.

Next come the 6 tie-unloaders, who with the teamsters unload the ties upon the road-bed, and following them the 12 tie-spreaders working in 4 gangs of 3 each, one of the 3 with a pick squares the ties across the road-bed, while the other 2 with picks space the ties 2 ft. apart center to center, taking care to place at the end of the panel two selected ties of same size as nearly as possible to come under the rail-joint. Behind these are the 3 tie-liners, who with picks and a ½-in. rope 400 ft. long align the end of the ties on the north (or line side) measuring with a 4-ft. stick from the track centers at each station of 100 ft.

Then the tie-surfacer, with pick and shovel, who lowers all high ties to give an even surface on them for the rail.

These 23 men, with a water-boy, constitute the gang of tie-wrestlers. At a distance generally 1,000 ft. behind the tie-wrestlers follows the iron car, a stout, low, flat car, about 10 ft. long, 7 ft. wide, and 2 ft. high above the rail, with steel rollers on each side at each end and a trough in the middle to hold straps and spikes, upon which is piled a car-load of 44 rails, 5 kegs of spikes and 44 straps, and is dragged forward by a couple of mules driven tandem fashion.

Just in front of this car is the front-gauger, who holds the forward ends of the rails to a gauge as the iron car comes on them, this preventing the track from spreading at that point. Six men run on each side of the iron car, and as it comes to a halt at the end of the last laid rail they run out a bar on each side, and at the word "down" by the heelers they cast the rail upon the ties and launch it back toward the last rail, and the car is immediately run forward another rail length, and this operation repeated until the car has made 22 stoppings and the load of 44 rails is upon the track.

The heelers stop the car at the end of each rail with a wooden chock thrust under the wheels, and each time they throw out a pair of straps, and at the end of every fifth rail a keg of spikes.

The iron car is then speedily run to the rear to be reloaded, the 12 men and the foreman riding upon it, and the mules pushed to a gallop; and this iron car is loaded and unloaded 16 times a day, each car-load of 44 rails laying 660 ft. of track, in all 2 miles.

At each loading of the iron car, about one-half of the straps (22 pair) are thrown into the middle trough, the balance with the 5 kegs of spikes upon the top of the loaded rails.

At each loading 16 men in a line all grasp the rail on the ground, and, raising it up, walk to the side of the car, and at the word "over" by the heeler, throw the rail upon the car, while the foreman, at the rear end, with an iron nipper, and a heeler at the front end arrange the rails side to side upon the pile; it generally requires 10 minutes to load and the same time to unload, and about 15 minutes to run the empty car from the end of track back to the iron pile and back again (loaded) to the end of track, in all 35 minutes, and this repeated 16 times exhausts the 10 hours work per day.

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*The company has now prepared an agreement, which it makes and gives to each owner who has already signed, giving consent, and to each owner who will sign until a majority of assessed value is obtained, securing to them this full paid and unassessable stock.

*The present capital stock is $1,000,000, fully subscribed.

† Aug. 31, 1881.

The rails are laid "square joints," that is, the ends of each pair of rails are opposite to each other and rest upon the same pair of joint ties; for awhile the broken joints were laid where the end of a rail on one side of the track was opposite to the middle of the rail on the other side.

The "suspended joint" is also used where the straps rest at each end on the joint-ties, instead of upon the tie as in the "supported joint."

Besides the front-ganger and a tool-car man and these 12 track-layers, there are 6 men belonging to this gang who unload the rail from the flat cars to the ground, and these 20 men and a water-boy constitute the iron gang.

Close upon the heels of the track-layers come the strappers, 8 in all. Working in couples, one on each side of the track at opposite joints, the first couple untrimming the straps by removing the nuts and locks from the bolts and placing them upon the joint-ties convenient for the other 3 couples, who, coming along, strap the joints by giving the rail the proper expansion distance, and fasten the straps on with the four bolts (nuts and washers on outside of rail).

The 3 couples use expansion bars and strapping wrenches: the first is an octagonal ⅞-in. steel bar, 3 ft. long, straight, rounded to a point at one end and flattened at the other like a screw-driver, while the strapping-wrench is a ½-in. round-iron bar with a wrench-socket to fit a 1-in. square nut.

With these 2 tools a strapper manipulates the connecting ends of the rails so as to throw them into proper position and adjusts the straps, securing a snug fit of all the parts and tightens up the nuts. These straps are of rolled iron angle-plates, 2 ft. long; a pair with bolts, nuts and washers weigh 35 lbs., and each mile requires 352 pairs.

Immediately following the strappers is a tie spacer, who with an iron bar throws the 2 joint-ties under the straps so as to bring the slots in the straps convenient for the spikers. After him comes the spike-peddler, distributing 4 spikes on the 1st, 5th, 9th and 13th tie, to be spiked by the front-spikers, a spike on each side of each rail.

Following the spike-peddler are the front-spikers, 4 gangs (2 on each side) of 2 spikers and a nipper, 12 men in all.

Each spiker has a spike-maul, a long-handled hammer something like a ship-carpenter's calking-mallet, the handle 3 ft. long, the hammer 15 in. long, 2 in. in diameter, and weighing 10 lbs.

Each nipper carries a nipping-bar, something like an inch round iron crow-bar 5 ft. long, and a nipping-block 16½ in. long by 6 in. square, to use as a fulcrum to the lever of the bar in raising the end of the tie, so as to give a solid resistance to the blow of the spike maul.

And the nipping-block is also used by the lead-spikers on the line side to measure the distance between the outside of the rail and the end of the tie to insure a line to the rail on the ties, the gauge keeping the other rail in line.

The front spikers spike the 1st, 5th, 9th and 13th tie in each panel, and these would be every other tie in a half-tied track. The 2 lead-gangs spike the 1st and 9th ties, while the other 2 gangs take the 5th and 13th, each gang skipping 8 ties in moving up. The track is thus spiked at joints, centres and quarters, or what is called "quarter-spiked track." The gangs on the line side keep just ahead of those on the other side, and tha track-gauges are carried by the inside men on the south rail. In driving the spikes the outside man, placing his spike close up to the rail, tacks it to the tie by a slight tap. When the inside man gives it the first blow, then the inside man tacks his spike to the tie, and his partner gives it the first blow; then both proceed to drive their respective spike, generally with 5 to 6 well-directed blows, the last blow being so given as to drive the spike-head snug up to the flange of the rail, the nipper in tha meanwhile keeping the tie solid against the rail. The spikes are 5½ in. long by $\frac{7}{16}$ of an inch square, weighing ½ lb. each, packed in kegs of 150 lbs., or 300 spikes, and as 4 spikes are used to each tie it requires 10,560 spikes per mile, or 35 kegs, or 1 keg for each 10 rails laid down. Spikes were furnished by the Tredegar Iron Works, of Richmond, Va., and Dilworth, Porter & Co., of Pittsburgh, Pa. These 8 strappers, 12 spikers, spike peddler and tie-spacer, 22 men in all and a water-boy, are called the lead-gang, and are under charge of Mr. John Painter, the superintendent of the track-laying. Closely behind these comes the track-train, pushing to the front another loaded iron car, and it consists of a tool car, 3 dining cars, 8 cars of iron, locomotive and tender, 1 wooden and 2 iron water cars; 8 cars of iron being about 1,000 ft. long and handled by a 10-wheel Pittsburgh locomotive. The tool car is an ordinary low flat car and has 2 large lock-boxes or tool-chests to contain the picks, shovels, bars, mauls and other tools when not in use, and is in charge of a man belonging to the iron-gang, who mends up broken and sharpens dull tools and takes care of them all.

The dining cars are 60 ft. long by 11 ft. wide, and 9 ft. high in the clear, with platforms at each end. Of these dining cars, the 2 on the ends are for the laborers, and will seat 80 men, having a long table and a shelf on one side, giving each man 2 ft. of elbow-room. The middle dining car is in 2 departments, one 40 ft. long for the kitchen, and the other 20 ft. for the foremen, seating the 8 foremen and the 12 trainmen.

In the kitchen a Charter Oak range, No. 335, and a Charter Oak stove, No. 40, are used to cook and bake for 250 men. This department is in charge of a steward, who employs a gang of 15 men, viz.: Two cooks, 1 baker, 7 waiters, 2 scullions, 1 wood-chopper and 2 watermen.

The 16 cars of iron on this train are loaded on flat cars 35 ft. long, each containing 44 rails weighing each 600 lbs., 26,400 in all; 44 straps of 35 lbs. each, 1,540 lbs., and 5 kegs spikes of 150 lbs. each, or 750 lbs.; total load on each car of 28,690 lbs., say 14 tons. The rails being neatly loaded flat, edge to edge, in two tiers of 22 rails each, one tier up-side down between the other, with the straps and spikes thrown on top.

As this track-train is run to the front to push up the loaded iron-car, the 6 men (iron-unloaders) who had been in front helping in loading the iron car, step on the rear of the train and unload a fresh car of iron.

Four of the 6 men remain on the car and throw off first the straps and spikes, and then the rails, one-half on each side of the track, while 2 of the men remain on the ground and straighten out the pile to prevent bending the rail.

The men in throwing iron off the car use crow or pinch-bars, 1-in. round steel bars, 5 ft. long, slightly bent at the lower end to serve as a skid, and care is taken to unload the iron where it can be handled again in reloading on the iron car, avoiding high embankments and narrow rock cuts.

The general custom is to try and unload the rear car first, and the front car last, so that if any car should happen to be still loaded at night, it would be next to the dining cars, and could remain on the track with them at night to make part of the train next day.

If the rail had been loaded on the flats with 50 bars to a load, only 7 cars would be required to each mile of track, but this load with straps and spikes would weigh 30,500 lbs., rather too heavy for the iron car.

The rail used has been furnished by the Cambria Iron Co., Manhattan Iron & Steel Co., and the Allentown Rolling Mills, is 30 ft. long and weighs 60 lbs. per yard, or 600 lbs. per rail, or 100 tons per mile.

The water-tubs with this train consist of 2 iron round and 1 wooden square tank, the iron tanks being 5 ft. in diameter by 24 ft. long and the wooden tank 8 ft. wide, 16 ft. long and 4 ft. high, each capable of containing 3,600 gallons of water or 100 barrels.

The water in the wooden tank is used for drinking and cooking purposes, and is conveyed to the kitchen by a water-wagon.

The water in the iron tanks is used, one for the tie-teams and the other for the locomotive, which requires about 120 bbls. each 24 hours.

This water is supplied from the wells along the line of the road every 20 miles, and is delivered by the water-train of 12 tank-cars to the siding where the material for each days work is made up into trains convenient to the end of the track.

The wells are dug 16 ft. square and 50 ft. deep, supplied with steam pumps and round wooden tubs of 600 bbls. capacity.

THE TIE-TRAIN.

Following within 1,000 ft. of the rear of the track-train is the tie-train of 14 cars, each loaded with 125 ties, weighing 25,000 lbs., and a round iron-tank water-car accompanies this also.

These ties are unloaded 4 or 5 cars at a time, the balance being pushed forward as fast as the movement of the track-train will allow.

Generally, this tie-train is brought out to the point at 7 a. m., another at noon, and a third at 4 p. m., requiring 42 car loads to 2 miles of track.

Sometimes 16 car loads come at 7 a. m., 14 at noon and 12 at 4 p. m.

These oak ties come from the line of the Texas & Pacific Railroad, east of Mineola, and are now hauled 600 miles to the end of track.

To handle these ties, unloading and loading, requires 40 men, working in 10 gangs of 4 each, who, with two-water boys, constitute the "tie-loading gang."

When track was laid through the White Sand Hills sawed heart-pine ties were used, each car-load of 250 ties weighing 32,000 lbs., requiring only twenty-one cars for two miles.

These heart-pine ties, 6 in. × 8 in. × 8 ft., weighing 125 lbs. each, can be loaded twenty to a wagon, requiring only two men to handle them, and can be distributed, spaced and lined with great ease and facility.

BACK-SPIKERS GANG.

It will be necessary now to leave the shade of the before-mentioned mesquite bush and have the ardent rays of an August sun to see the working of those gangs who bring up the rear and finish up the work left undone by the front gang. And the first gang we meet is the back-spikers, 35 men and a water-boy.

This gang is generally a mile or so behind the tie-train, and as they close up the gap, spiking in full all ties skipped by the front spikers make a regular racket.

This gang is divided into ten gangs of two spikers and a nipper, five gangs on each rail, making twenty spikers and 10 nippers, with two tie-spacers and two spike-pullers and a back-strapper.

A push-car goes with this gang to carry a water-barrel and such loose spikes and bolts as may be left along the track.

The spikes are all driven "staggered," that is, the spikes on the inside of the rails are driven nearest to the west edge of the tie, while the spikes outside of the rails are driven nearest tha east edge, thus inside spikes are opposite each other, outside ditto.

The spikes are started and driven perpendicular, close to the rail, and snugly fitting the flange, while care is taken at the joints to spike the slots in the strap.

The tie-spacers square and space the ties again, and the back-strapper tightens up any loose bolts overlooked by the front-strapper.

TRACK-LINING GANG.

About a mile behind the back-spikers come the track liners – 6 men and a water-boy, and a foreman, whose duty it is to align the track accurately to the centers given by the engineer.

These track-centers are pine pegs, with a tack in each, driven at each 100 feet on tangents, and each 50 feet on curves.

With a gauge-stick the foreman places the rail on the line-side in position, several stations at a time, and then with lining-bars his men (three on a side) throw the track either way as he directs, and this is repeated as he goes forward until the line is adjusted.

Some liners, as they put the rail on the line-side in position at each tacked-center, place a small rock or lump of dirt on the ball of the rail to assist their eye in getting the line for several stations at a time, say 10 stations, and keep this up until they are satisfied with the alignment as far as their eye can reach.

BACK-FILLING GANG.

Behind the liners, at a distance of a mile, comes the back-filling gang of 32 men and a water-boy, in charge of a foreman, whose duty it is to cast in dirt from the side-ditches and spoil-banks on to the road-bed, between the ties, to keep the ties apart and prevent them from bunching together, and at the same time to make a kind of water-shed along the center line of the track to drain the rain-water from the road-bed.

A push-car goes with this gang to carry a water-barrel and loose tools, and two of his men are detailed to move the ties that may have been misplaced since spiking, and to see that all are properly squared and spaced.

The surfacing up and ballasting of the track is performed by another contract and is some ways to the rear of the track-laying outfit.

The road-bed is graded transversely level, except on curves, where a cant of ½ in. to each degree of curvature is given to the outside.

THE SIDE-TRACK GANG.

Besides these 7 gangs heretofore enumerated, is a gang of 16 men and a water-boy, called the side-track gang, and in charge of a foreman, whose duty it is to put in the side tracks to be met with every 10 miles, as well as all "Y" tracks, material-tracks, spurs, etc., necessary to a depot yard.

A push-car goes with this gang to transport about the frogs, switch-rails, switch-ties, etc.

The side trakes are 1,800 ft. long, south side, 15 ft. canters, with Reynolds' patent safety split switch-stand, and a two-story section-house on north side, about half way between head-blocks, and a tool-house adjoining the yard.

These back gangs are brought in to dinner by the return loaded tie-train, and carried out again by same train going for a third load of ties.

THE TIE-HAULERS.

The 44 teamsters who drive the tie-wagons have their dinner brought out to them from camp by a wagon, which on its return carries back a full load of car standards and shattered ties, to be used as fuel.

The teamsters' camp is moved each Sunday to a point 6 miles west of the end of iron, so that the track-laying will pass it again on Wednesday evening, or about the middle of the week.

This camp consists of 3 large boarding tents, each to accommodate 20 men; a tent for the foreman or wagon-master and his corral boss; a store tent to contain the corn, oats and bran, and 6 smaller tents to sleep 10 men each, as well as a shed for the blacksmith shop.

The force consists of fifty teamsters, a corral boss, a herder, a night watch, a road-maker, the iron-car driver, a blacksmith, a wagon repairer and a veterinary surgeon—58 in all—besides the 3 cooks and their assistants, all in charge of a wagon-master.

The daily feed of the 50 teams is 30 bushels of oats, 20 of corn and a half ton of hay and some wheat bran.

THE BOARDING-TRAIN.

The boarding-train is set out on a spur-track and is moved once a week, and consists of 3 sleepers, a dining-car, a store-car, contractors' car, bookkeepers' car, engineers' car, physicians' car, supply car, trainmens' caboose-car, and in all is about 500 ft. long.

The 3 sleepers and the dining-car are each 66 ft. long from out to out, with boxes 60 ft. long, 11 ft. wide and 9 ft. high.

The sleepers accommodate 70 men each, in double bunks on each side, 3 tier high, the foremen having a compartment to themselves in the end of the front car.

The dining-car is like those on the track-train, and will seat 80 men comfortably, and is for the convenience of any gang left east of the boarding-train, as well as those employed about the boarding-train, and sick men unable to go to the front, and the night crews on the two trains.

The other 7 cars are ordinary box-cars fitted up conveniently for the parties designated above.

The store-car contains groceries and dry-goods, suitable for a community like ours, with clothing, boots, shoes, hats, caps, tobacco, etc.

In here is kept the post-office, as the mail is carried back and forth twice a week between the boarding-train and Colorado City, in Mitchell County, the last established post-office on the line of this railroad.

The physician-car is occupied by the train physician, who has a complete stock of drugs, and is prepared to attend to all persons requiring a physician or a surgeon.

In this car also is domiciled Dr. Montgomery, the honorable U. S. Commissioner, who presides to examine all charges made against parties for violating the U. S. Revenue laws by selling liquor without proper permits, etc.

He is assisted by a U. S. Deputy Marshal.

The supply-car contains commissary stores for the use of the train, such as flour, meat, etc.

The trainmen's caboose-car is occupied by the night crews in the day and by the day crews in the night time.

Near the east end of the train is a tent occupied by the family of one of the men, who wash and iron for all who feel like paying $1.50 per dozen for such a luxury.

The butchers' camp goes generally with the teamsters' camp, and his herd of beef-cattle are kept where water and grass can be found convenient. He kills two beeves per day, and finer and fatter meat was never seen.

The telegraph line is kept up with the boarding-train, the office being in the engineer's car, who sends at night to the chief engineer a daily report of track laid and other work done and number of men and teams employed.

After 6 p. m. the track-train and the tie-train are backed to the boarding-train, where the three dining-cars are left on the main track all night, while the two locomotives, with the empties, go east to the next side-track for the material and water needed for the next day, returning generally about midnight, and sometimes daylight.

This requires a night and day crew on each train, consisting of a conductor, engineer, fireman and two brakemen, and on the night crew a watchman and a wiper. These 22 trainmen are in charge of a master of transportation, who regulates the movements of the trains, and gives all train orders.

The water is brought from the last well to the supply side-track by a water-train in charge of Mr. Killpecker Brown, whose duty it is to keep up the supply of water with the 12 tank-cars at night, and in the day to bring up whatever material he can, and his movements (somewhat eccentric) are supposed to be controlled by the Pacific Railway Improvement Company.

As the contract stipulates that the track-laying contractor shall not haul material beyond 30 miles, the track is inspected and accepted in 30-mile sections by the Texas & Pacific Railway Company, who at once establish a terminal agent and make it a point of delivery.

The fourth division of 100 miles from Fort Worth, which has just been ironed, had on it three tangents, the first 10 miles, the second 42 miles, and the third 47 miles long, joined by 30 minute curves.

The maximum grade was 50 ft. per mile, with only 5 miles of this, the remainder averaging 10 ft. per mile.

The only bridging was a pile bridge 1,600 ft. long and an iron bridge of 100 ft. span over the Pecos River.

So with the road-bed, built through a gently rolling, sandy prairie, with easy grades and comparatively no curves and so little bridging, a remarkably excellent line has been located and a road built, easy to keep up, and admitting of heavy trains and great speed.

In the hot days of June, July and August, the men drank on an average three gallons (one bucketful) of water each, and a gang of 30 men, like the back-fillers, used a barrel of water each morning and evening.

Each water-boy carries two water-buckets for his gang, one of water, and the other of oat-meal and water.

One quart of oatmeal is used to the bucket of water, and having a sweet-milk taste, the men are fond of it, as it also prevents cramp and nausea in hot weather, and a barrel of oatmeal is thus consumed each week.

The coal used on the locomotives is furnished by the Gordon Coal Co., from their mines about 3 miles north of Gordon Station, in Palo Pinto County, 105 miles west of Dallas, Tex.

This coal, delivered at the terminal station, costs $6 per ton, requiring 25 tons per week per engine and 200 tons per month for the two.

The working hours are from 7 to 12 in the forenoon, and from 1 to 6 in the afternoon, 10 hours in all; 50 per cent. extra time is given for Sunday and double time for night work, sometimes necessitated by accidents.

Wages.—The 18 iron-gang men and the spikers get $2.50 per day; the balance get $2; teamsters and train-boys, $1.50. In all the wages aggregate $675 per pay, and the daily expense, including wages, trains, wear and tear of machinery, feed of teams, and loss of tools, etc., is about $900.

The rolling-stock was furnished by the Pacific Railway Improvement Company, but the furniture, bedding, table and kitchen ware, cooking utensils, tools, etc., cost about $10,000, while the 50 teams, wagons and harness cost $20,000, in all $30,000.

Résumé of Force Employed.—23 tie-wrestlers; 20 iron-car men; 22 lead-spikers, etc.; 40 tie-loaders; 35 back-spikers, etc.; 32 surfacers; 6 liners; 16 side-track gang; 58 teamsters, etc.; 15 steward crew; 22 trainmen; 10 water-boys; 10 foremen; 11 others, consisting of general manager, track superintendent, bookkeeper, storekeeper, mail-messenger, surgeon, train-master, watchman, two servants and a water-man; in all 320 men.

To manage this force judiciously and economically required great executive ability, patience, energy and tact, and in this Messrs. Coleman & Co. were greatly assisted by General Manager M. W. Stoll and Track Superintendent John Painter.

The track contractors are Messrs. Michael S. Coleman & Co., the Coleman Brothers, of Madison, New Jersey, of whom Col. M. S. Coleman is now constructing the tunnel under Bergen Hill; Major James Smith Coleman is Street-Cleaning Commissioner of New York City, and Peter Coleman is a railroad contractor in New York State.

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THE DRIVING OF THE FIRST TUNNEL THROUGH THE ROCKY MOUNTAINS.

Thursday, Jan. 5, 1882, will for many years to come be a red-letter day in the estimation, not only of the citizens of Helena, but of the people of all parts of Montana Territory; for upon that day the work of driving the tunnel for the Northern Pacific Railroad through the main range of the Rocky Mountains under Mullan Pass was formally inaugurated.

A large number of guests were invited by the contractor, Mr. James Muir, to witness the first operation on the proposed tunnel at Railroad Gulch, about 15 miles from Helena. The engines, boilers and air compressors, which furnish the driving power for the tunnel, are situated at the head of Railroad Gulch, which terminates abruptly against the walls of the summit of the Rocky Mountains. The tunnel enters the mountain at an elevation of about 180 ft. above the machinery plant and is reached by steps cut into the mountain side.

Governor B. F. Potts and Mayor Kissner acted as drillmen, and at 1:30 p. m. the compressed air was turned on and the drills, striking at the rate of 300 times per minute, with a driving force of 750 lbs. to each stroke, began their entrance into the granite walls. Each drill penetrated the solid wall to a depth of 6 ft. within about 20 minutes and the work of driving the tunnel through the range was declared to be fairly commenced.

A dinner, with its accompanying speechmaking, followed. The first toast, "The Territory of Montana," was responded to by Gov. Potts, who, in closing, proposed the following: "To the officials and employés of the Northern Pacific Railroad, from the chief managers of the great enterprise, President Villard and Vice-President Oakes, down to the men who remove sand and gravel."

Col. J. T. Dodge, engineer of the Rocky Mountain Division, responded in a happy speech, of which we give only the first part:

It is very fitting that we should assemble here to-day to celebrate the beginning of one great step in one of the great enterprises of the age. In seeking a route across the Main Range of the Rocky Mountains, we came here to the lowest of all the available passes. We find passes with elevations above the sea level as follows: Deer Lodge Pass, 5, 68 ft.; Little Pipestone Pass, 6,455 ft.; Mullan Pass, 5,773 ft.; Dry Cottonwood Pass, 6,807 ft. Ascending from Ten Mile Creek by a grade as steep as the steepest on the Baltimore & Ohio, the great representative steep grade road, we still fall 280 ft. short of attaining this summit. Although the line is developed along these hills to the utmost practical limit, crossing two immense ravines at the height of nearly 90 ft., and making a way through the projecting spurs by heavy rock cutting, still we find ourselves in this narrow valley, shut in by rocky cliffs too high to be surmounted or to be overcome by an open cut. The grade on this line as now run passes 363 ft. below the surface and emerges in a beautiful, broad and fertile basin on the other side. Our only escape from this environment is by a tunnel 3,850 ft. in length, or nearly three-fourths of a mile. It is to be made 16 ft. wide and 20 ft. high to the crown of the arch. The material bids fair to be solid granite, from end to end, and of uniform quality, unless we should happen to find a mine of the precious metals. The material, as you have seen, is to be moved in cars on an iron track, and is to form the large embankment at the eastern end. It is not unlikely that we may meet numerous veins of water, sufficient to form quite a rivulet, as was proved, although it appears so dry and impervious now. But with our modern appliances for blasting, water offers little hindrance to the work.

The able and experienced contractor, Mr. James Muir, to whom the company entrusts the work, expects to advance 5 ft. per day from this end, and to continue work day and night from this time on until its completion.

Two steam boilers and two powerful air compressors will furnish power for operating the great drills with which holes will be sunk 10 ft. deep. The air which transmits the power will, by its liberation, furnish pure air to the workmen. Giant powder, which is the fitting accompaniment of these power drills, will rend these rocks with a force never known until the latter half of this century. Engineers with their lamps and instruments will make their weekly visits to the dark cavern to give the proper points to guide the work as it progresses.—*Exchange.*

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THE ATLANTIC AND GULF COAST CANAL.

Among the improvements to which we would call attention as likely to take shape in the year before us, is the construction of canals connecting the lagoons which extend for nearly the entire length of the Florida coast from St. Augustine south. By taking advantage of some creeks and rivers a line of inland navigation for medium draft steamers through these lagoons can be had protected from the ocean by islands or strips of land seaward, for a distance from the St. Johns River of 330 miles, at a trifling cost. What will render the undertaking a promising enterprise is the fact that the Canal Co. have also the right to drain the Okeechobee Lake of some 1,000 square miles area, which lake, now without outlet, in times of freshets backs the water up the various streams which find their only discharge into it, and submerge millions of acres of the richest agricultural soil in the world, with a climate proverbial for its salubrity.

Proper examination has revealed the fact of the easy drainage of this lake by cuts leading to both seas, the ocean on one side, and the Gulf of Mexico on the other—and the construction of the canal will open some 8,000,000 acres to the enterprise of our Northern farmers and to the pleasure travel of a large class of our people who appreciate the delights of a semi-tropical vegetation of wondrous beauty.

The prospectus of the Atlantic and Gulf Coast Canal & Okeechobee Land Company, making all possible allowances for the interested view very naturally taken by proprietors, still leaves a margin of the wonderful advantages of this enterprise, which is worthy of careful study.

The work has been examined and reported upon by James M. Kreamer, C. E., Philadelphia, and the company, of which Wm. S. Stokely is President, have their office at northeast corner of Third and Chestnut streets, Philadelphia. The estimated expense requisite to bring this wonderfully productive soil into market is so small in view of the result to be attained that there can be small doubt of the ultimate success of the undertaking.

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JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR............ ....ASSOCIATE EDITOR.

SATURDAY, JAN. 21, 1882.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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ANNUAL MEETING OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The twenty-ninth annual meeting of the American Society of Civil Engineers was held at the House of the Society, 127 East Twenty-third street, on Wednesday, the 18th inst. The increasing interest in the Society is shown by the yearly increase of attendance at the annual meeting, and in this respect the present one is most noteworthy. Representatives from nearly every section of the country were in attendance and the interest manifested by all was very gratifying. Vice-President Ashbel Welch occupied the chair, and gentlemen who stand well at the head of the profession filled the rather small meeting-room, and a glance at the gathering would convince any observant person of the truth of the remark made by a gentleman from a foreign country, who, after looking over the party, said: "I have attended meetings of scientific and professional bodies in all parts of the civilized world, but I never saw a gathering of men in whose faces was visible so plainly the intellectuality, force, and that peculiar business-like appearance which make you Americans the most progressive and energetic people on the face of the globe. As representatives of the nation they are a credit to it, and equally so a credit to their profession."

The following is as full a list of members and visitors present as it was possible to obtain: Lyman Bridges, Chief Engineer California Central Railway; Theodore N. Ely, Pennsylvania Railroad; Octave Chanute, Chief Engineer Erie Railroad; Sanford Fleming, ex-Chief Engineer Intercolonial & Canada Pacific Railroad, of Ottawa, Canada, Chancellor of the Queen's University, Kingston, Canada; David Reeves, Phœnix Iron Company, Philadelphia, Pa.; Henry G. Morse, of the Morse Bridge Company, Youngstown, O.; Joseph M. Wilson, engineer of bridges and buildings of the Pennsylvania Railroad; Joseph Waltz, City Engineer of Dayton, O.; Charles Kellogg, of the Kellogg & Maurice Bridge Works, Athens, Pa.; F. C. Prindle, United States Navy; William H. Bradley, Superintendent of Sewer Construction, Boston, Mass.; Martin Coryell, Lambertville, N. J.; Charles G. Darrach, First Assistant Engineer of the Philadelphia Water-Works; Gen. Theodore G. Ellis, Engineer on the Government improvements on the Connecticut River, Hartford, Conn.; William P. Shinn, New York City; William H. Searles, Engineer of the West Shore Road, Newburg, N. Y.; Marshall M. Tidd, Boston, Mass.; Charles E. Fowler, City Engineer, New Haven, Conn., and Albert B. Hill, his first assistant; Gen. William Sooy Smith, Chief Engineer of the Hudson River Tunnel; Capt. Otto E. Michaelis, Ordnance Corps, United States Army; William Metcalf, Crescent Steel Works, Pittsburg, Penna.; Erasmus D. Leavitt, Jr., Chief Engineer Calumet & Hecla mine, Lake Superior, Mechanical Engineer of Lynn & Lawrence (Mass.) Water-works and constructor of the sewerage pumping engines of Boston, Cambridgeport, Mass.; Samuel M. Gray, City Engineer, Providence, R. I.; David M. Greene, Director of the Rensselaer Polytechnic Institute, Troy, N. Y.; Clark Fisher, Trenton, N. J.; Theodore Cooper, New York; L. L. Buck, Central Railroad of New Jersey, New York; Col. W. H. Paine, Francis Collingwood, C. C. Martin and G. W. McNulty, Engineers East River Bridge; Geo. W. Dresser, *American Gas Light Journal*, New York; John Bogart, Secretary of the Society; J. J. R. Croes, Treasurer of the Society; Alfred P. Boller, Chief Engineer Albany & Greenbush Bridge; George H. Frost, ENGINEERING NEWS; Thomas C. Clarke, Phœnixville Bridge Works; George R. Morison, Chief Engineer Bismarck Bridge N. P. R. R.; Henry D. Blunden, First Assistant Engineer Erie Railway; William H. Wiley, of Wiley & Sons, Publishers; Henriques Harris, Engineer Manhattan Beach Railwey; Jas. McCrea, Supt. N. Y. Div. Pennsylvania R. R.; Julius W. Adams, Past President A. S. C. E., ENGINEERING NEWS; E. S. Chesbrogh, Consulting Engineer New York City; Thomas M. Cleeman, Philadelphia; Joseph P. Davis, Vice-President and Chief Engineer Metropolitan Telephone Co., New York; Prof. T. Egleston, Columbia College, New York; Charles E. Emery, Engineer New York Steam Heating Co., New York; Bryant Godwin, New York City; Wm. H. Grant, New York City; Wm. E. Hutton, New York; Gabriel Leverich, Brooklyn; Charles Macdonald, President Delaware Bridge Co.; Cook Talcott, Newark, N. J.; Charles D. Ward, Jersey City; W. E. Worthen, New York City; Charles Ward Raymond, Assistant Engineer Hudson River Tunnel; Sebastian Wimmer, New York City.

The report of the Secretary showed an active membership of 655, besides honorary and corresponding members and fellows. During the past year 62 members and 2 fellows were admitted and the losses by death and other causes were 19.

The society has 9,607 volumes, 116 manuscripts, 2,157 maps, charts, etc., 258 models and specimens, its especial feature being the large collection of reports and monographs on railroads and statistics relating thereto. The demands made upon the society for skilled engineers, and the inability to fill these demands were alluded to as an evidence of the growing importance of the profession. The lack of prizes to be offered for competition by writers of engineering essays was regretted, there now being but one prize—the Norman medal—which, by the way, was not awarded, owing to the illness of one of the censors. At a later stage in the meeting an additional annual prize of $50 was created, to be known as the Rowland Prize, in honor of T. F. Rowland, the largest contributor to the building fund. The Treasurer's report showed receipts for the year of $16,834.60, and disbursements, $14,330.81. The fellowship fund aggregates $10,002.75. Receipts for the building fund ware $14,012, and' disbursemants, $10,931.88. It was decided to hold the annual convention in Washington, D. C., next spring, at a date to be fixed upon by the directors. The following officers were elected for the ensuing year: Ashbel Welch, Lambertville, N. J., President; James B. Eads, St. Louis, Mo., and William H. Paine, Brooklyn, N. Y., Vice-Presidents; John Bogart, New York City, Secretary and Librarian; J. James R. Croes, New York City, Treasurer; Thomas C. Keefer, Ottawa, Canade; Col. Thomas L. Casey, Washington, D. C.; Joseph P. Davis, George S. Greene, Jr., and George W. Dresser, New York City, Directors. On taking the chair as President, Mr. Welch returned thanks for the honor, said the fact that applications for membership in the association from all parts of the country, Mexico, Chili, United States of Colombia, British Columbia, Canada, England and India showed that the people of the world were becoming cemented together in bonds of universal brotherhood, and urged upon the society the necessity of such care in the selection of its members as preserves the purity of the bench and the army.

The Committee on Standard Time, by its chairman, Mr. Sanford Fleming, reported, and it proposed that the American Society of Civil Engineers should take the initiative step and invite the governments of the United States, Canada and Mexico to join in a convention to establish standards of time for North America, to which the scientific societies of the countries named shall be invited to send delegates, the governments, societies and scientific men to be invited to send suggestions as to the best plan to be adopted looking toward the end in view. This recommendation was adopted. Gen. Theodore G. Ellis, of Hartford, Connecticut, explained that the United States Government had already in its Signal Service taken steps looking toward the establishment of a standard for this service, and is now having constructed at Waltham, Mass., for this service, a clock made upon the most improved plan, and which is to be finished in February and which will be kept in a room whose temperature will not vary 1° in a year. This is done because the time taken at existing observatories varies a few seconds daily, owing to the fact thot their clocks are kept in rooms where the temperature varies from 1° to 10° daily. This absolute standard upon a settled meridian, probably that of Washington, he has been informed, was desired by the post-office and other departments, and any standard fixed upon by such a convention would undoubtedly be most acceptable to them.

Lunch was served in the rooms of the society, after which the subject of testing iron and steel and other building materials was discussed, the outcome of which was the passage of a resolution instructing the Board of Direction to memorialize Congress to appoint a commission to resume the work of investigating into tha strength of structures and the materials of which they are composed, with the further recommendation that the commission be composed of practical men, who shall publish the results of their tests, first without comment, for the benefit of experts and people interested in the practical results of the experiments, who may then draw their own deductions. Gen. Sooy Smith advocated most strenuously the establishment of such a commission, to be outside of the War Department, whose members should be paid for their services and appointed by tha President.

Mr. Chas. E. Emery exhibited plans and gave an explanation at length of the methods of the New York Steam-Heating Company, after which the meeting adjourned.

According to programme, on the 19th the members met at 10 a. m., at the Manhattan Gas Works, corner of Eighteenth street and Tenth avenue, and after witnessing the operating of the Ross steam stoking machinery, and the "latest thing" in coal chutes, they were taken by the Pennsylvonia Railroad steam tug "America" to the Jersey City end of the Hudson River tunnel, where, under the leadership of the chief engineer, W. Sooy Smith, they visited every portion of the works. The party explored the south tunnel only, which is open for about 430 feet to where the air-lock is now fixed. Through the air-lock the more adventurous seekers after underground knowledge proceeded as rapidly as parties of about 25 could be passed; the balance of the party, more hungry for hard-tack, small beer and Roquefort cheese, than experimental tests in compressed air, returned to the tug, whither they were, after a proper interval, followed by the clay-bedaubed contingent that had braved the dirt and danger of the big bore to its very face. These made short shift of the remnants of the "collation" when they once got within reach of the biscuits and beer. The next landing was at the Brooklyn end of the East River bridge, time not allowing a stop at the Pennsylvania Railroad depot grounds, as had been proposed. Up the high circular ladder of over one hundred steps, as on a corkscrew, this crowd of several score men, tall and short, heavy and light, lifted themselves to the roadway of the big bridge, and after halting a moment or so to take breath and a view of the magnificent prospect, the cavalcade proceeded across the bridge on some planks that had been laid down for the purpose. The process of riveting by hydraulic pressure was witnessed, and to the cool-headed ones who could stop without feeling sick at the stomach or light in the head, any amount of information on suspension bridge construction was vouchsafed by the engineers of the bridge who convoyed the party. This is the *first* party, excepting workmen, that has crossed on the roadway of the East River bridge. We "enjoyed" the privilege of crossing on the foot bridge suspended from the towers, in 1878, and having successfully accomplished this later feat in "walking a plank" over a swift-running stream 130 ft. below, are quite content to wait for some more flooring and a railing, before we cross again. The views from the bridge at almost any point on it are unsurpassed by those from any other station in the city or vicinity. Having descended the "corkscrew" at the New York tower, the party proceeded by boat to the Courtland street dock of the Pennsylvania Railroad, and thence, under the intelligent leadership of Mr. Chas. E. Emery, visited the boiler-house of the New York Steam-Heating Company; stood round in the mud, and looked into tha street trenches where pipe laying was going on, as well as they could, and then visited the office and looked over the plans. Mr. Emery is engineer for the company, and he took a great deal of interest in explaining and exhibiting everything in connection with his work. After being well surcharged with steam heating, and with feet pretty well soaked by street slush, tha party re-embarked and proceeded to the works of the Dock Department at Twenty-third street. As we didn't go, we do not know what the party thought of what they saw, but we take it for granted that they were well pleased, and especially so when they got a chance to get back to their hotels, where they could "see a man" and warm th ir well-chilled bodies.

The reception and its accompanying dinner, held in the evening, were as eminently enjoyable as such "specialties" in engineering practice usually are. If under the influence of the excellent "exhilarators" always provided by the society's committee, and the charming eloquence of such orators as Messrs. Worthen, Dresser, Fink, Bogart, Cooper, Boller and Andrews, besides others too numerous to mention, a party of fifty gentlemen cannot have a "good time," then such a thing as a "good time" cannot be had. Old acquaintances were renewed, and men whose names are as familiar as household words in the profession, but who were personally unknown to each other, were formally introduced, and every effort was made by the committee to render the occasion as agreeable as possible. There were no toasts and no speeches, the only outbreak in that direction being "A Turnip Story," as related by a distinguished engineer, and which was listened to with bated breath and expectant countenances by all within earshot. The party broke up at midnight. The following is the menu, which was furnished by Iauch, of Fifth avenue, near Twenty-third street:

AMERICAN SOCIETY OF CIVIL ENGINEERS.

ANNUAL MEETING,

SUPPER MENU.

Raw Oysters
Oysters a la poulette.
Fried Oysters.
Chicken Croquettes.
Chicken Salad.
Lobster Salad.
Paté of Game.
Boned Turkey.
Roast Quails
Salmon—Tartar Sauce.
Sandwiches.
Rolls.
Green Fruits.
Assorted Fancy Cakes.
Ice Cream in Fancy Form.
Meringue Chantilly.
Rum Punch. Coffee.
Claret. Sauterne. Punch.
Champagne.

JOHN BOGART,
GEORGE W. DRESSER,
WILLIAM H. PAINE,
C. VANDERVOORT SMITH,
CHARLES E. EMERY,
} Committee.

House of the Society, 127 East 23d st., New York, January 19, 1882.

List of members and guests present: Charles Paine, General Manager, and Walter Katté, Chief Engineer N. Y., Lake Ontario & Western R. R.; Leffert L. Buck, Central R. R. of N. J.; Stephen S. Haight, Topographical Department, N. Y. City; Julius W. Adams, *Past President A. S. C. E.*, ENGINEERING NEWS; Theodore Houston, C. E.; Wm. H. Paine, Asst. Eng. East River Bridge; Chas. G. Darrach, First Asst. Eng. Philadelphia Water Department; Wm. D. Bullock, Asst. City Engineer, Providence, R. I.; Joseph P. Davis, Vice-President and Chief Engineer Metropolitan Telephone Co., N. Y. City; Thomas J. Whitman, Water Commissioner, St. Louis, Mo.; Joseph Waltz, City Engineer, Dayton, O.; C. Vandervoort Smith, Chief Engineer Manhattan Gaslight Co., N. Y.; Samuel M. Gray, City Engineer, Providence, R. I.; Alfred P. Boller, Chief Engineer Albany & Greenbush Bridge Co.; E. D. Leavitt, Jr., Engineer Calumet and Hecla Mine, Lake Superior, and designer of the Pumping Engines Boston Improved Sewerage; Geo. E. Harding, C. E., New York; P. H. Dudley, the "Dynograph" inventor; Charles Macdonald, President and Chief Engineer Delaware Bridge Company; Geo. W. Dresser, Editor *American Gas Light Journal*, New York; Octave Chanute, Chief Engineer Erie Railway; Wm. Sooy Smith, Chief Engineer Hudson River Tunnel; J. T. Sanderson, C. E.; Wm. A. Haven, Engineer in Charge Construction Buffalo Div. N. Y., L. O. & W. R. R.; Cook Talcott, C. E., Newark, N. J.; Robert Escobar, C. E., Delaware Bridge Co.; William E. Worthen, C. E., New York; Ashbel Welch, President A. S. C. E.; E. H. Talbott, *Railway Age*; E. R. Andrews, President Hayford Creosoting Works, New York; Chas. S. Maurice, Bridge Builder, Athens, Pa.; Frances Collingwood, Assistant Engineer East River Bridge; Chas. Kellogg, Bridge Builder, Athens, Pa.; C. C. Waite, Secretary to the President, Erie Railway; Chas. E. Emery, Engineer N. Y. Steam Heating Co.; Chas. Ward Raymond, assistant Engineer Hudson River Tunnel; M. N. Forney, *Railroad Gazette*; Samuel H. Shreve, Chief Engineer Brooklyn Elevated Railroad; Geo. H. Frost, ENGINEERING NEWS; Martin Coryell, Chief Engineer Water Works, Lambertville, N. J., and brother; Wm. E. Hutton, Consulting Engineer, N. Y. City; E. S. Chesbrough, Consulting Engineer Department Public Works, N. Y. City; Geo. S. Morison, Chief Engineer, Bismarck Bridge, U. P. R. R.; S. Clarence Ellis, Assistant City Surveyor, Boston; Oliver W. Barnes, Chief Engineer Southern Penn. R. R., N. Y. City; Prof. R. M. Thurston, Stevens Institute of Technology, Hoboken, N. J.; C. W. Lewis, C. E.; Lyman Bridges, Chief Engineer California Central R. R., San Francisco; —— Goad, C. E.; Montreal, Can.; D. Von Nostrand, Publisher, N. Y.; Henry D. Blunden, (First Assistant Engineer Erie Railway; William H. Allaire, C. E.; New York; Jas. C. Aldrich, C. E., North Scituate, R. I.; Wm. H. Wiley, Publisher, New York City; Lieut. Holmes, United States Army, New Brunswick, N. J.; Chas. H. Haswell, C. E., New York City; Thos. C. Clarke, Phœnixville Bridge Works; H. Bissell, Master of Maintenance of Way Eastern Railroad, Salem, Mass.; T. E. Brown, C. E.; Thos. M. Cleeman, C. E., Philadelphia; Sebastian Wimmer, Sr., C. E., New York City; Sebastian Wimmer, Jr., New York City; Wm. H. Bradley, Superintendent of Sewers, Boston, Mass.; Sanford Fleming, ex-Chief Engineer Dominion Government & Canada Pacific Railway, Ottawa, Can.; William Metcalf, Crescent Steel Works, Pittsburgh, Penna.; Albert B. Hill, Assistant City Engineer, New Haven, Conn.; Prof. William Watson, Boston, Mass.; Prof. H. S. Monroe, Columbia College, New York; A. R. Haddock, W. Kingsford, Ottawa, Can. Mr. Maclin, England; George S. Baxter, New York City; Albert Fink, Past President American Society Civil Engineers, Commissioner of Pool Railroads; Geo. S. Greene, Jr., Chief Engineer Dept. of Docks, New York City; Mr. Seward, F. O. Norton, New York City; Theodore Cooper; Civil Engineer, New York City; Jno. Bogart, Secretary American Society Civil Engineers; Wm. P. Shinn, Civil Engineer, New York; James McCrea, Supt. N. Y. Div. Pennsylvania R. R.; Richard Schermerhorn, Chief Engineer and Supt. B. B. & Coney Island R. R.; Clark Fisher, Trenton, N. J.; Bryant Godwin, Civil Engineer.

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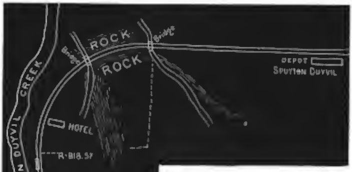
THE SPUYTEN DUYVIL ACCIDENT.

On the evening of the 13th, an accident occurred at Spuyten Duyvil on the New York Central and Hudson River Railroad, which resulted in the death of 8 persons and the serious injury of many others.



The train known as the Atlantic express leaves Albany at 2:40 p. m., and on account of its speed and convenient time of starting, is a favorite train with people traveling toward New York. The Legislature, when in session, usually adjourns in time to permit those of its members who so desire to take this train to the city, and on the present occasion it was well filled with legislators and representatives of the press. The train consisted of thirteen cars, the last six of which were drawing-room cars. It was about thirty-five minutes late when it left Albany, and it had nearly made up lost time when—for some reason as yet unknown—it came to a halt on the end of the first curve after passing Spuyten Duyvil station.

A local train from Tarrytown waited until 6:40 p. m., when the express went by and the local followed. According to the statement of the engineer of the local he stopped at Spuyten Duyvil at 7:14, and according to the time-board was then thirteen minutes behind the express. Soon after leaving the station—the position of the trains will be readily understood by consulting the accompanying drawing—he entered a cut at the commencement of a sharp curve and which was just wide enough to permit of two tracks and where the walls were jagged and perpendicular. This cut extends about one-half the distance of the curve, and after leaving it the view of the track beyond the tangent point is completely and effectually hid by a building, situated as shown on the drawing. The Tarrytown special swept around this curve and did not see the express until within 150 or 200 feet of it. A terrific crash followed, the rear palace car being telescoped on to the next one and both set on fire. Owing to the rapidity with which the flames spread nothing could be done toward rescuing the passengers who were imprisoned by the timbers of the rear car. The palace cars were made by the Wagner company, and in the rear car was State Senator Webster Wagner of that company.

The cause of the accident seems to rest with the rear brakeman, who, according to the rules of the company, should have gone back half a mile to signal the local. The engineer of the local testified before the coroner that when he first saw the flagman he (the engineer) was not more than 350 feet from the end of the cut, his view being obstructed by the smoke-stack, bell and sand-box of his engine. Had the brakeman gone back about 700 feet, he would have reached the cut between the rocks, through which a track-walker passes after each train in order to see that no obstructions have fallen upon the track. From there he could have signaled the track-walker, even if he had been at the other end of the cut, and thus prevented the accident. Had he gone back the required half-mile, he would have passed through the cut. Owing to the positions of the hotel and the standing train, it was impossible for the engineer of the local to see the rear lights while at a distance sufficient to avoid a collision.

Last Monday one of our reporters visited the scene of the accident, and judging from the burnt ties of the position of the last car (see the sketch) it would have been impossible for the approaching train to have seen the brakeman in time to stop if the brakeman was only thirty or forty feet in the rear of his train. As before stated, the position of the hotel is such as to hide the straight stretch until the approaching train has nearly rounded the curve.

The engineer stated to the jury that he was going at the rate of 18 or 20 miles an hour, and that the distance from the end of the cut to rear car of the express (700 ft.) would have been sufficient for him to have stopped his train had he been properly signaled.

On Thursday last the jury visited the scene of the accident in order to thoroughly understand the case.

The following-named gentlemen, all of this city, constitute the coroner's jury, and from the professional calling and eminent standing of some of the members, we hope the stereotyped form of verdict in such cases will be omitted and the real cause of the accident ascertained:

Egbert L. Viele, civil engineer; Henry J. Davison, civil engineer; Edward Haeuser, restaurant keeper; William H. Weightman, engineer; Henry Eichling, mechanical draughtsman; Leander T. Howes, banker; L. E. Schmieder, dry goods; Charles H. Haswell, civil engineer; David H. McAlpine, tobacco manufacturer; Francis J. Burke, real estate; John Peyser, saddlery, and Isaac Teichman, cigars.

* * *

NEW YORK STATE REPORT PUBLIC WORKS.

We make space for extracts from the report of the State Superintendent of Public Works, S. B. Dutcher, as calling attention to matters of grave import in the bearing of the policy pursued in reference to our State canals upon the commercial prosperity of the city of New York, and incidentally to the material interests of the State at large.

The report is clear and emphatic, and merits the careful consideration of our legislators. Some of the facts which it presents do not make pleasant reading, but the Superintendent has done his duty faithfully in presenting them in their naked aspect without gloss or varnish of any kind. The tolls have fallen off, the tonnage has decreased, the season has been unpropitious to the boatmen, and the very maintenance of the canals imperilled by the constitutional amendment limiting the annual expenditures. The time is approaching when the question must be looked squarely in the face, whether the commercial supremacy of the city of New York does not call for the abolition of all tolls on the canals, and the expenditures necessary to maintain them in their efficiency be made a tax on the people of the State, or borne by some interests which may properly be made to contribute to that end.

Expenditures on canals for fiscal year ending Sept. 30, 1881:

Ordinary repairs and operating expenses.........	$807,324.36
Extraordinary repairs.........	85,864.93
Total.........	$893,189.29

As stated in the report of last year, the structures of the canals, especially the locks and bridges, had not received the attention during the past few years that was necessary to keep them in proper condition.

The expenditure in rebuilding, repairing and improving this class of structure alone was the sum of $68,180.18.

* * * * *

Work, estimated to cost about $800,000, recommended by the Engineer Department as necessary to put the canals in good order, and restore them to their original condition as when first enlarged, has not been done because of want of funds and time.

* * * * *

The tolls and tonnage during the past seven seasons of navigation have been as follows:

	1875.	1876.	1877.	1878.
Tolls...	$1,590,032	$1,340,004	$880,[illegible]	$993,348
Tonnage..	4,859,958	4,172,129	4,955,963	5,171,320

	1879.	1880.	1881.
Tolls...	$941,574	$1,155,419	$632,380
Tonnage...	5,362,372	6,457,656	5,175,505

The tolls for the season, as compared with that of 1880, have fallen off over 45 per cent., while the decrease in tonnage is only 20 per cent. This large decrease in receipts does not verify the predictions expressed to the Legislature and the Canal Board by the advocates of lower tolls when the same were under consideration by those bodies.

The average tonnage for the previous six years, 1875 to 1880, inclusive, was 5,163,233 tons; for 1881, 5,175,505 tons, showing the tonnage greater for the latter season than the average for the previous six years. The decrease in revenue is due in part to the abolition of tolls on west-bound freight, but in much larger measure to the lessened shipments of through cargoes of grain from Buffalo to the seaboard; more than three-fourths of the decrease is justly chargeable to the latter cause. The shipments of grain and breadstuffs from Buffalo in 1880, were 71,909,964 bushels; in 1881, 31,151,761 bushels; the tolls on these shipments in 1880, were $700,199, in 1881, $290,444. The decrease in east-bound freight tonnage is owing to a lessened export demand; a smaller surplus of agricultural produce in the West, and the competition of the railroads, which has been unparalleled.

The season has been a most disastrous one to boatmen.

The freights on east-bound merchandise have averaged lower this season than ever before in the history of the canals.

* * * * *

The following table shows the receipts and exports at the five principal ports in our own country and the one principal port of Canada, from January 1 to November 30, in the years 1880 and 1881, and confirms the statement, before made, that the decreased tonnage by canal is in large measure due to the lessened demand for our products abroad.

RECEIPTS.

Ports.	1880. Bushels.	1881. Bushels.		
New York ...	161,127,802	135,001,504	Dec. 16	per ct.
Baltimore ...	53,850,534	41,431,502	Dec. 23	"
Philadelphia.	45,276,667	27,502,665	Dec. 39	"
Boston.......	31,762,548	34,351,780	Inc. 7	"
New Orleans.	21,100,039	18,855,180	Dec. 10¼	"
Montreal.....	23,628,013	19,984,165	Dec. 15	"

EXPORTS.

Ports.	1880. Bushels.	1881. Bushels.		
New York ...	122,307,913	90,571,083	Dec. 26	per ct.
Baltimore....	45,146,811	33,775,675	Dec. 25	"
Philadelphia.	30,470,733	18,153,103	Dec. 40	"
Boston.......	18,760,267	16,142,150	Dec. 14	"
New Orleans.	14,860,111	12,483,798	Dec. 16	"
Montreal. ...	25,846,310	17,506,133	Dec. 32	"

CONSTITUTIONAL AMENDMENTS.

The revenues during the fiscal year, which the expenditures for collection, superintendence and repairs for the fiscal year ending Sept. 30, 1883, cannot exceed, were $818,264.61.

Expenditures equal to those receipts will, unless there is some great disaster, secure good navigation during the remainder of the year; but if the receipts for the balance of the present fiscal year, from the opening of navigation to Aug. 31, are not larger in proportion than for the portion which has elapsed, from Sept. 1 to close of navigation, the maintenance of the canals will be periled the following year.

The lessened export demand and less surplus products in the West, coupled with the greater facilities by the St. Lawrence and Mississippi routes, furnish no reason to expect larger receipts during the spring and summer of 1882 than during the same period in 1881, and justify the assumption that the revenues for the fiscal year ending Sept. 30, 1882, will not exceed the revenues of the calendar year 1881, or about $632,000, an amount less than the expenses of collection, superintendence and repairs during any year since the enlargement.

The improvements on the Mississippi River and the enlargement of the Canada canals, affording increased facilities and lessening the cost of transportation by those routes, make it absolutely essential that the cost of transportation shall be lessened from the lakes to the seaboard, if New York is to maintain her commercial supremacy.

The facilities afforded by the canals for many years over any other route added much to the resources of our State, brought vast amounts of capital to our commercial centers, added largely to the volume of taxable property in those centers, and thus reduced the burden of taxation in other portions of the State.

The tolls during the past season of navigation have been about 20 per cent. of the cost of transportation on through cargoes to tide-water. Freeing transportation from this tax will undoubtedly add much to the volume of business, make available the large investment in boats and canal equipment, bring additional capital to our large cities, and again cause large additions to the volume of taxable property in those cities. Making the canals free will benefit the State if future Legislatures are prudent in making appropriations and those in charge of the canals are economical in their expenditures. Lavish appropriations and unnecessary expenditures would soon produce a feeling of indignation that would prompt the people to abandon these highways of commerce.

The State can well afford to maintain them if prudently managed as a regulator of freight rates. The terminal and all port expenses should be made as moderate as possible, thus relieving our commerce of every unnecessary tax and charge.

From the completion of the canals to the present time, the tendencies of many of the cities and villages through which they pass has been to construct and maintain their sewers so as to empty the same into the canals.

This is not surprising, as, passing through the central portions of the cities, they furnish an easy and inexpensive mode of drainage.

To such an extent has this practice prevailed that it has at last not only become a great public nuisance, but a heavy burden upon our already over-taxed canal revenues. The canals are not only used as an outlet for sewage matter, but are regarded by the adjacent owners as a common receptacle for all the garbage and débris from the streets. The health of the people is a matter of such importance that it should receive our first consideration. The present condition of the Erie canal cannot be regarded in any other light than as a channel for the distribution of disease and pestilence the entire length of the State, and especially so on the western division.

For this condition of things the people residing in its immediate vicinity are alone responsible. The cases of Buffalo and Lockport need only be cited to confirm this charge, and illustrate the importance of enacting such statutes and inaugurating such measures as will relieve the citizens residing in those cities, or adjoining the Erie canal between the same, and those engaged in its navigation, from this health and life-destroying nuisance.

A large portion of the sewage of the city of Buffalo, conveying the offal and refuse from many of their slaughter-houses and distilleries, is emptied into the Main and Hamburgh canal, and is thus conveyed to the Erie canal, where, mingling with its waters, it is moved forward, and its baneful effects are visible nearly or quite as far eastward as Rochester. For many miles the stench during the heated term is almost unbearable, and results in sickness and death not only of those engaged in navigating the canal, but to those residing adjacent thereto, to an alarming extent. Men not only invest their money in the necessary equipment of the canals, but the boatmen take their wives and children on their boats—the boat is their home—the home of many of them during the whole year. The State should protect them against such unnecessary exposure to disease and death.

The complaints from Lockport to this department during the past season have been frequent, and petitions for relief to its citizens from the Buffalo sewage have been strongly urged by those having the health and prosperity of their people at heart. Yet in the face of these complaints, and at the same time, nearly the entire sewage of the upper town of Lockport was discharged into the Erie canal, and no efforts were being made by the proper authorities to find other channels for the same. An engineer of large experience estimates that more than 200,000 cubic yards of the sediment deposited along the bottom of the canal on the western division is chargeable to this cause alone, of which more than three-fourths is justly chargeable to the Buffalo sewers and manufactories.

From these evils the present statutes afford no relief, and the subject is presented as one imperatively demanding immediate legislation. Cities and villages along the line should be required to find other outlets for their sewers, and individuals and corporations prohibited from making the canals a repository for refuse or débris of any description.

In the case of the city of Buffalo, the State, by the construction of the canal, cut off the natural drainage of the city to the lake, and unless some relief is afforded by the State a heavy burden is cast upon the city in her efforts toward sanitation, and the true policy of the State should be to endeavor foster to this effort rather than to cripple it.

THE IRON TRADE.

[Prepared specially for ENGINEERING NEWS.]

It may be too soon to inquire into the probability of the completion of all the numerous enterprises on the carpet for the current year. Far seeing investors are discounting all kinds of possibilities and probabilities. Some of them are entitled to consideration. Some are not. The value of railroads and railroad stocks are made to depend largely on the volume of our export trade, while that in turn depends on, mainly, the condition of foreign crops, the necessities of foreign consumers and their ability to purchase. There is a commercial battle in progress between the leading nations. American supremacy as a cotton producer is conceded, but the supremacy in wheat will not be conceded without a vigorous effort to organize agricultural activity in Britain's colonial dependencies, which may possibly liberate that country from too great dependence on our markets for breadstuff supplies. The connection between these considerations and the prosperity of engineering enterprises is, in brief, this: if it pays to keep on building railroads, engineering talent will find corresponding activity; if not, only moderate activity will characterize engineering operations. Within a few days practical steps have been taken looking to the organization of ship-building enterprise. It is apparently anticipated that the powerful political, commercial and manufacturing influence, now about organized for action before Congress, will result in positive and satisfactory action on the part of the Government. In fact, the feeling on the necessity of a merchant marine and lines of vessels with foreign ports is no longer confined to a few presumably interested parties, but is participated in by all classes, even to farming interests, who therein recognize that such aids are essential as links in the chain which connects their barns and granaries with foreign consumers. In fact, the feeling on the subject of lines of ocean steamships is akin to that which made a protective tariff in 1861 a welcome expedient to many who otherwise had theoretical objections to it. An export trade is now demanded by farming and manufacturing interests as well as commercial interests, and when such interests harmonize there are probabilities of practical results. The importance of this movement and the strength of it is observed by closely observing people abroad, and enterprise is warned to be on the alert for such possible victories and inroads on British supremacy on the high seas as were secured in the domain of manufactures, through the primary agency of the Morrill Tariff of 1861. The activity already displayed in ship building in the coast-line and harbor service is an indication of the vitality which changing circumstances and conditions is infusing into the shipping interests so long neglected. The Cramps at Philadelphia have inquiries relative to their probable facilities for executing contracts next spring and summer. The same, in fact, is true of some of the lesser concerns on the Delaware and elsewhere. The necessities of commerce are forcing a revival of ship building. The builders of marine engines and the manufacturers of iron and steel for use in ship building are busily engaged with urgent orders for work of this character. Enterprise in this direction is not being repressed by any inflation of prices in raw material. That a revival in ship building is near at hand none can doubt who take occasion to observe the course of events. Congress is evidently disposed to do the bidding of those most highly interested. Definite plans have been prepared, but not all friends of more ships are in accord. The improvement of our shipping interests opens a wide door for engineering enterprise and capital, which will be entered promptly.

Already the demand for iron and steel is being felt in the chief centers. Prices are very firm. Steel is especially in active demand, and lower grades have been advanced. The larger works are expanding their capacity. The magnitude of the probable demand has not been estimated. The activity at Sheffield and other foreign steel centers prevents any vigorous competition; but there is no disposition to take all the market will bear, as it is said railroads are sometimes disposed to do. Such a course would be productive of several evident evils, among which are competition of new firms and fluctuating prices. The blast-furnace industry has a heavy responsibility to face in maintaining supplies for the extraordinary consumption, which certainly will not grow less. The rolling mill interests are overrun with orders and are unable to accept all. Foreign markets are firm and hence imports are very light. Manufacturers checked the advancing tendency by declining to make an advance; a policy which has demonstrated commendable foresight. Meetings are to be held in the East and West on Monday next to take a view of the iron situation, and in view of a probable advance, declared formerly by a resolution, or effected by active demand, manufacturers have endeavored to avoid long or heavy engagements. Nails have been advanced by the action of makers at Pittsburgh, Harrisburgh, New York and Boston. Extraordinary activity in building operations is anticipated, and makers are running to fullest capacity to meet the requirements of the spring trade promptly when it comes.

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PERSONAL.

MR. JOSEPH E. WALTZ, City Civil Engineer of Dayton, O., was in the city this week to attend a meeting of the Alumni of the R. P. I. He was also a guest of the Amer. Soc. of C. E. at its excursions and reception on Wednesday and Thursday.

MR. THEODORE COOPER, Mem. A. S. C. E., of 35 Broadway, is rebuilding the cement works of F. O. Norton, Esq., at Binnewater, near Rondout, N. Y. The old works were recently destroyed by fire, and Mr. Norton now intends to remodel the plant and increasing its capacity.

MOSES LANE, City Engineer of Milwaukee, Wis., and one of the best known hydraulic engineers in America, has been so prostrated by a stroke of paralysis that his life is despaired of. The many friends of the afflicted engineer will be pleased it more favorable news is received next week.

MR. PURCELL, Division Engineer on the Georgia Pacific Railroad, was seriously injured by the fall of a construction train through an undermined trestle about 8 miles from Columbus, Miss., on Sunday last.

GEO. WM. BALLOU has been elected Vice-President of the Mutual Union Telegraph Company.

SIDNEY T. FULLER, Mem. A. S. C. E., ex-Chief Engineer of the Philadelphia, Wilmington & Baltimore Railroad, has been appointed General Superintendent and Chief Engineer of the North Division of the Mexican National Construction Company and the Mexican National Railroad Company; also, General Superintendent and Chief Engineer of the Texas & Mexican Railroad. His duties as General Superintendent and Chief Engineer extend over all the lines of these companies north of San Luis Potosi, and also will include the Matamoras Division.

THOMAS J. WHITMAN, water commissioner of St. Louis, Mo., and who was at the annual meeting of the A. S. C. E. this week, had a strange experience recently. He accidentally swallowed a common wooden tooth-pick; pains were felt some time afterward in his back, and a few days ago the intrusive cause of them was cut out of his back just above the hip.

GENERAL SIR WILLIAM ERSKINE BAKER, R. E., K. C. B., died on the 17th inst., at his residence, the Castle, Banwell, near Weston-super-Mare, England, at the age of 73. The deceased held successively in India the appointments of Superintendent of the Delhi Canals, Superintendent of Forests and Canals in Sindh, Director of the Ganges Canal, Consulting Engineer to the Government of India for Railways, and Secretary to the Government of India for Public Works.

DR. CARL CULMANN, the eminent engineer, died at Zürich on Dec. 9. The deceased was born in 1821, at Bergzabern, in the Bavarian Palatinate. He was best known as a railway engineer, and designed many bridges both for German and Swiss railways, and other important works. He made Switzerland his permanent home when, on the foundation of the Polytechnic School of Zürich, he accepted an appointment on the teaching staff as professor, which he held for twenty-five years. He was the author of "Die graphische Statik," and was just on the point of completing a second edition of this work when death overtook him. He contracted a disease on a professional trip to Constantinople, which proved mortal; but he was able to reach his adopted home, were he breathed his last.

R. P. I. ALUMNI.

That the engineering profession is not completely engrossed in the dry calculations of strains and stresses, sectional forms, or the removal of heavy materials, may be inferred from the reports of the past two weeks of the several assemblages of the profession held throughout the country. Of the strictly social events, the second annual reunion of the Alumni of the Rensselaer Polytechnic Institute, held at the Hoffman House, this city, on Tuesday evening of this week, must take precedence. The deep interest in their Alma Mater expressed by certain of its alumni led to an initiative reunion last year, when the Hon. Clarkson N. Potter opened his hospitable mansion for the occasion, the pleasant results of which were duly chronicled in this journal. The eminent success of that event may be said to have insured the success of the future, and the alumni meeting of the R. P. I. may now well be considered as a "regular thing" for each ensuing season.

At the meeting on Tuesday evening, Mr. B. F. Greene, an old-time Director of the Institute, and now a retired officer of the U. S. Navy, presided, and about one hundred gentlemen, mostly all prominent members of the profession, assisted in doing justice to the menu provided in the usual excellent style of mine host of the Hoffman. The first regular toast of "Our Alma Mater," was responded to in some pleasant reminiscences by President Greene, which were supplemented by a timely letter in the same line from W. W. Evans; by the exhibition of an autograph letter from the old Patroon, Gen. Van Rensselaer, the founder of the Institute, and by the reminiscences of Messrs. Le Grand B Cannon and Prof. E. N. Horsford, who thumbed the text-books of the school some half a century ago.

The second toast, "What the Rensselaer Institute has accomplished and what we owe to it," was responded to by Mr. Strickland Kneass, Vice-President of the Pennsylvania Central Railroad.

"Technical Education; what is it?" was answered by President Henry Morton, of the Stevens Institute.

"The Press" was responded to by Mr. Jo Howard, Jr., and "Engineering and the Law," in the absence of the person selected to respond, was answered by Mr. A. P. Boller. "The American Society of Civil Engineers" was responded to by Mr. John Bogart; "The Institute of Mining" and "Our Sweethearts and Wives," by Dr. R. W. Raymond, and "The Descriptive Geometry of Steel," by William Metcalf.

The committee on entertainment were Messrs. Chas. Macdonald, Pres. of the Delaware Bridge Co.; J. M. Wilson, Philadelphia; Joseph P. Davis, Vice-Pres. of the Metropolitan Telephone Co., and Prof. H. B. Nason, who certainly deserve much credit for the able manner in which their duties were discharged.

The bill of fare was a work of art, giving vignettes of student life, such as the students passing the young ladies from the seminary with the words "eyes left," "Botanizing," "Castleton," where annual surveys of diverse kinds are made; a fine view of the Institute buildings, of the East River Bridge, of running a transit line, etc.

The following is the *menu:*

MENU.

HUITRES—Blue Point.
R-oysterers, welcome!
POTAGES. *Amontillado.*
A sop for Cerberus, or any other man.
Bisque d'Ecrevisse à la St. Gervais.
Printanier Dorsey.
Variés. HORS D'ŒUVRES. Variés.
Bouchées à la Reine.
POISSON.
Be careful, this Poisson may give you a—Sauterne.
Saumon, sauce Génevoise.
ENTREE. *Pontet Canet.*
Now bind the filet on her brow—(poetical license or strain.)
Filet de Bœuf piqué Providence.
Poularde braisée à la Vénitienne.
Galantine de Faisan en Bellevue.
ENTREMETS.
Some spell it salary.
Petits Pois. Pommes, Duchesse.
Haricots Verts.
Céleri braisé au Jus.
SORBET AU KIRSCH.
Cigarettes de Kimball.
ROTI. *Chambertin.*
The student by a maid was struck;
He fairly quail-ed before the duck.
Quails. Mallard Ducks.
Salade de Laitue.
ENTREMETS SUCRE.
Mumm, Dry Verzenay.
Charlotte, keep mumm.
—Old Play.
Charlotte à la Russe Gelée Rubanée.
Glacé.
Corbeille Jardinière.
Corne d'Abondance Sultane Parisienne.
Gateaux assortis. Petits Fours.
Fromage.
Fruits.
Cognac. Café. *Cigars.*

It was after midnight when the last guest departed, and we doubt not that these reunions will have a good effect in firing the ever-youthful hearts of the graduates of the Institute with enthusiasm for their dear old, and somewhat moss-covered Alma Mater.

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ENGINEERS' SOCIETIES.

A FLOURISHING SOCIETY OF ENGINEERS.

The Society of Engineers of Western Pennsylvania on the 16th elected the following officers for the ensuing year: President, A. Gottlieb; Vice-President, William Thaw, Jr.; Directors, A. Dempster and M. V. Smith; Treasurer, A. E. Frost; Secretary, J. H. Harlow. The society has 250 members, plenty of money in the treasury and an interesting library.

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ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, NO. 1523 CHESTNUT STREET, PHILADELPHIA, PA.

Record of Regular Meeting, Dec. 17, 1881.

Vice-President Henry G. Morris in the chair. Twenty-six members and two visitors present.

Mr. T. M. Cleemann exhibited photographs of and described several examples of ancient Roman masonry. He regarded as the most important and remarkable, for its excellent preservation, the aqueduct at Nismes, in the south of France, which was built at about the beginning of the Christian era, and represents the engineering skill of the Romans when their power was at its height. It consists of three tiers of arches, the two lower being similar and superposed on one another, the upper tier of much smaller dimensions, upon the top of which runs the water channel. The various arches differ in span—lacking the regularity and conformity to one pattern of modern works. The center line was likewise not perfectly true, showing that no transit had been used by the Engineer in Charge.

The approximate dimensions are as follows: Largest arch, span 75 ft., piers 15 ft. (by Rankin's rule about 11½ ft.); ring stones, 4 ft. thick (Rankin, 2½ ft.); water channel, originally 6 ft. × 4 ft., rectangular, now reduced by calcareous deposit nearly 1 ft. thick. Bond of piers, alternate header and stretcher, in courses of about 18 in.

In the lower tier the arch-stones are laid in four, and in the middle tier in three rings, without bond; in the upper tier in two rings, breaking joint. Closely laid rings, without bond, were also observed in a Roman bridge at Avignon.

Numerous stones projecting from intrados and face are supposed to have been left to support centers and scaffolding during construction. The whole structure seems to be founded on rock.

An aqueduct near Rome and the Basilica of Constantine were also described. The latter was built about A. D. 300, and consists of bold arches, 66 ft. span, of brick, one abutment of which is only about one-third of the radius of the arch, which is considerably thinner than Rankin's rule would require, but the use of old Roman cement has reduced the structure to almost a monolith.

Mr. Thomas C. McCollum contributed a block, cut from a pile which had been under water but three months near Pensacola, Fla., and, not having been creosoted, was completely honeycombed.

Prof. L. M. Haupt read a letter from Mr. Walter Shanly, C. E., upon the water transportation routes from the Northwest to Europe.

Several communications from members of the club were read.

HOWARD MURPHY,
Secretary and Treasurer.

The fourth annual meeting of the Engineers' Club of Philadelphia was held on Jan. 14 at their new rooms No. 1,523 Chestnut st., President Strickland Kneass in the chair, 38 members present.

The annual reports of the secretary and treasurer were read, showing the club to be in good financial condition and an increase of membership of about 50 per cent. during the past year.

The retiring President, Mr. Strickland Kneass, gave a résumé of the progress of the engineering works under construction and that are in preparation, not only in our own country and Mexico but also in Europe and Asia, showing that Mexico is rapidly rising in the scale of nations by introducing internal improvements in the shape of extensive railroad lines and that the Chinese have at length been convinced that the barbarians have some ideas that may safely and advantageously be adopted for advancing the interests of the "flowery kingdom," and have therefore begun the construction of railroads and telegraphs.

In alluding to electricity and its use for illuminating, the number of inventors and the variety of lamps, both of the arc and incandescent systems, the deep interest the subject claims from the scientists of the day was shown. As a motor, electricity was also spoken of, when its earliest adaptation as a motive power was given to Jacobi and his little boat on the Neva in the year 1839.

Compressed air as a motor was also referred to and its practical use for street railways in France. Allusion was also made to the improvements in the manufacture of steel so as to obtain a reliable material as a substitute for iron by the Bessemer, Siemens and basic processes, and the effect made upon the extensive ore properties of our own State that are now being developed at large cost for washing machinery and connecting railroads.

A short notice of telegraphy was given, showing Morse as the first American who practically applied the magneto-electric telegraph. Underground telegraph lines, it was shown, were in general use in Germany, and were being introduced in France, the credit of which belongs to the Postmaster General of Germany.

The importance of the exhibition of grates and furnaces, constructed to consume smoke and gases that now escape without adding any value to the combustion, was favorably presented.

His comparison of the state of the art of to-day as compared with fifty years past as applied to steamships and railroads, and the faulty prophecies of scientists and business men as to what could not be done, shows the futility of measuring the future by our own limited knowledge of the present.

The tellers of election announced that the following gentlemen had been elected officers for the ensuing year: President, Rudolph Hering; Vice-President, Percival Roberts, Jr.; Secretary and Treasurer, Howard Murphy; Directors, Strickland Kneass, Frederic Graff, T. M. Cleemann, J. J. de Kinder and Wilfred Lewis.

On taking the chair for 1882 Mr. Rudolph Hering said:

I am deeply sensible of the distinction conferred by you in assigning me to a position which has been so worthily filled by my honored predecessors. My grateful acknowledgments are due to you all, and I can only hope that my earnest efforts in behalf of the welfare of our club will be a proof of the keen appreciation of the signal favor shown me this evening, for which I beg you to accept my heartfelt thanks.

The club has just completed the fourth year of its existence and, owing to the large number of its resident members, already occupies a prominent place among the kindred societies of our country. Its rapid growth has fully confirmed the desirability of a closer professional intercourse among Philadelphia engineers, a point which was placed before us in a strong light during the Centennial Exhibition, when it was not an uncommon occurrence that introductions even among ourselves were necessary when meeting at the headquarters of the American Society of Civil Engineers.

In my position, as a director of the Club for the past three years, I have endeavored, as far as it lay in my power, to promote its interests, and now I shall spare no efforts to still further increase its usefulness, in doing which I shall hope for your hearty support and co-operation.

HOWARD MURPHY,
Secretary and Treasurer.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 14.)

CLXXVI.—ATTICA, N. Y.

Attica, New York, in lat. 42° 55′ N., long. 78° 20′ W. is on Tonawanda Creek in a valley between ranges of hills running north and south and rising about 300 ft. above the creek.

The town was settled about the middle of the last century. Water-works were built in 1879 by M. S. Frost & Son as a private enterprise. The supply is taken from Crow Creek, a small stream running between steep hills of slate rock. A stone dam 11 ft. high, 4 ft. wide at top and 7 ft. at bottom forms a small impounding reservoir on the stream from which the water is conducted to the distribution. Cast-iron pipe are used for distribution; 4 miles are laid, of from 10-in. to 3-in. diameter, with 20 fire hydrants and 73 taps. The town pays $50 per year for each hydrant. Service pipes are of galvanized iron.

The population in 1880 was 1,935. The consumption is not given. The capital stock of the company is $60,000. No statements of cost, expenses or receipts are furnished. H. W. Frost is the Secretary and Treasurer, and M. S. Frost the President.

CLXXVII.—CANAJOHARIE.

Canajoharie, New York, in lat. 42° 56 N., long. 74° 38 W., is on the south bank of the Mohawk River. Settled in 1800, and then called Roof's Village, it was incorporated as a village in 1829. Water-works were built in 1852 by a private corporation after the plans of J. W. Perkins. The supply is taken from springs issuing from a saturated gravel stratum, by two galleries or conduits, one 4 by 5 ft. and 90 ft. long, the other 2 by 4 ft. and 150 ft. long, and is distributed by gravity. The springs yield about 117,000 gallons per day. For fire purposes there is a reservoir 60 ft. square and 14 ft. deep, in excavation and embankment on a hill 185 ft. above the village and 92 ft. above the springs, to which water is pumped by a 4-in. pump driven by a 12-ft. overshot water wheel. The ordinary pressure in the mains is 18 lbs., and the fire pressure 50 lbs. per square inch.

Distribution is by cast-iron pipe of from 12 to 2-in. diameter, of which 2 miles are laid, with 11 fire hydrants and 100 taps. For the hydrants and two water-troughs the village pays $200 per annum. Lead pipe is used for service pipe. The population in 1880 was about 2,000, and the daily consumption 60,000 gallons.

The capital stock of the company is $10,000. The works have cost $12,500. There is a bonded debt of $2,500, bearing 5 and 6 per cent. interest. The expenses in 1880 were $140 and the receipts $1,008.

L. B. Clark is Secretary and Treasurer of the company and has been the Superintendent and General Manager since its organization.

CLXXVIII.—UNIVERSITY OF VIRGINIA.

The University of Virginia, in lat. 38° 2′ 3″ N., long. 78° 31′ 28″ W., near Charlottesville, is at the base of one of the spurs of the Blue Ridge and 2½ miles west of the Rivanna River. Toward the east the country is rolling and to the west mountainous.

The University was founded by Thomas Jefferson in 1825.

Water-works were built in 1858 after the plans of Charles Ellet, C. E. New works were built in 1868 after the plans of George Peyton, C. E.

The supply is taken from a reservoir in a ravine in the mountains, supplied partly by springs and partly by the surface drainage of about 50 acres. It is about 150 by 300 ft. surface dimensions, and is formed by a brick dam across the ravine, 20 ft. high and 100 ft. long at top. There are two walls laid in cement mortar and 6 in. apart, the intersecting space being filled with béton. The reservoir contains about 2,000,000 gallons and is 70 to 100 ft. above the University grounds. The outlet pipe is in a chamber inclosed by a double wall, with an intermediate space of 15 in. which is filled with charcoal. A 5-in. cast-iron pipe conveys the water 1 mile to the University, where it is distributed through 5,000 ft. of 3-in. pipe. There are 6 fire hydrants.

Before 1868, a No. 5 Worthington pump supplied the institution by pumping into tanks of 30,000 gallons capacity placed 60 ft. above the highest grounds. This pump and the tanks are still retained for use in emergencies.

The population supplied is about 600, and no record is kept of the quantity of water used.

The works have cost $28,132,20, and are in charge of the Superintendent of Grounds and Buildings. This position was held by William A. Pratt from 1858 to 1865, and by G. Peyton from 1868 to the present time.

CLXXIX.—BURLINGTON, N. J.

Burlington, New Jersey, in lat. 40° 9′ N., long. 74 53′ W., is on low, level ground on the east bank of the Delaware River. The town was founded in 1677.

In 1804 a private company built water-works, taking the supply from springs on high ground just south of the city, and conveying the water to the city and through High and East Broad streets in wooden pipes purchased from the city of Philadelphia, and which had been in use there for many years and were then being taken up and replaced by iron pipes. These pipes were of about 2-in. bore, and the supply was so limited that stringent regulations against the waste of water were enforced to the extent of fining a prominent citizen five dollars for giving water to a horse.

In 1843 Thomas Dugdale laid iron pipes through several streets and pumped into them from the river by a pump worked by a steam engine in a mill belonging to him. In consideration of the privilege of laying the pipes and furnishing water to consumers he supplied without charge 25 fire hydrants. In 1844 the mill was burned, and another engine erected by which the water was forced into seven iron tanks placed 50 ft. above the ground on a masonry foundation, which are still used.

In 1848 Mr. Dugdale purchased the property and franchises of the Aqueduct Company, and enlarged the reservoir or tank building, and erected an 8-horse power high-pressure engine and pump capable of raising 200,000 gallons per day.

In 1860 the works passed into the hands of a corporation styled the Burlington Water-Works Company, and in 1877 were purchased by the city for $25,000, and a Worthington compound duplex engine of 500,000 gallons capacity added. The water-tower was strengthened by building a masonry wall inside the old one, to which it fastened by iron clamps. The tanks, or reservoirs, hold 80,000 gallons. Distribution is by cast-iron pipe, of which 7 miles have been laid, of from 24 to 3-in. diameter, about 1½ miles being less than 6-in. There are, besides, 6 miles of old pipe laid by the company, and 2 miles of the wooden mains of the gravity system. The supply from the springs has greatly diminished, but is still used. A Birkinbine fire-protector enables a pressure of 65 lbs. per square inch, to be put on the mains for fire purposes. There are 87 fire hydrants and 1,038 taps. Lead service pipe is used.

The works constructed by the city were after the plans of Isaac S. Cassin, C. E.

The total cost to March 1, 1881, had been $64,600.66 and the receipts $35,000.

The bonded debt is $59,000, bearing 6 and 7 per cent. interest.

The population in 1880 was 7,855 and the daily consumption 148,011 gallons.

The expenses in 1880 for maintenance were $3,388.17 and the revenue $9,243.83.

The works are managed by five Water Commissioners appointed by the Common Council. Henry S. Haines is the Treasurer and Superintendent.

CLXXX.—WAUKEGAN.

Waukegan, Illinois, is in lat. 42° 30′ N. long. 88° W., on a bluff 80 ft. above and overlooking Lake Michigan. Settled in 1831, it was incorporated as a city in 1859. A water supply is procured from an artesian well, completed in 1875 to a depth of 1,134 ft. Rock is encountered 180 ft. from the surface, to which depth the boring is cased with a 4-in. iron pipe. The first pipe put in corroded and was replaced in 1881.

The water will rise to 65 ft. above the surface. The well discharges into a brick tank 20 ft. square and 20 ft. high, built half above and half below the surface of the ground, on the highest land in the city. The supply is copius and constant.

From the tank it is distributed by cast-iron pipe, of which 3 miles, mostly of 6-in. diameter, are laid, with 15 fire hydrants.

The population in 1880 was 4,031. The daily consumption is not stated. The yield of the well is in excess of the present demand. The cost of the well was $3,350. Revenue is not given. The works are owned by the city. J. F. Powell is the manager.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From A. H. Martine, Superintendent, Report of Fall River (Mass.) Water-works, Jan. 1, 1881; from H. S. Haines, Treasurer and Superintendent, statistics of Burlington (N. J.) Water-works, report for March, 1881, and water rates; from H. W. Frost, Secretary and Treasurer, statistics of Attica (N. Y.) Water-works; from G. Peyton, Superintendent, statistics of Water-works of the University of Virginia, Charlottesville, Va.; from L. B. Clark, Superintendent, Secretary and Treasurer, statistics and water rates of the Canajoharie (N. Y.) Water-works Co.; from J. F. Powell, Manager, statistics of Waukegan (Ill.) Water-works; from J. Albert Mills, Superintendent, reports of Water-works Commission of St. Catharine's, Canada, for 1879 and 1880.

CORRESPONDENCE.

ON PROBABLE ERROR.

DETROIT, Mich., Jan. 13, 1882.

The usual method of finding the probable error of the mean of a series of observations is from the formula

$$0.6745 \frac{SD^2}{n(n-1)}$$

using Prof Merriman's method as given in your issue of Jan. 7. This, though undoubtedly the most accurate method, requires considerable time in computation. The following rule, founded on rigid principles, will be found to give the probable error close enough for all practical purposes, supposing of course that the observations have been properly made.

A glance at the observed results will show the greatest and least, and their difference will be the *range* in the results. Then for the probable error (r) of a single observation we have if the number of results is

		2	$r =$ [illegible]	range.
		3	$r =$ [illegible]	"
between	4 and	8	$r =$ [illegible]	"
"	8 "	15	$r =$ [illegible]	"
"	15 "	35	$r =$ [illegible]	"
"	35 "	100	$r =$ [illegible]	"

The probable error of the final result is found at once by dividing the probable error (r) of a single observation by the square root of the number of observations.

T. W. WRIGHT.

THE BEST STUMP PULLER.

MILWAUKEE, Wis., Jan. 3, 1882.

EDITOR ENGINEERING NEWS:

Replying to inquiry of your correspondent, Mr. L. J. Fisk, under date of Dec. 1, 1881, I will say that the Chamberlin stump pulling machine is the best one in use, according to my experience. The address is Chamberlin & Sons, Olean, N. Y.

Will you, or some of your readers, please inform me as to the best and most practical machine for sawing piles 10 to 12 feet under water, and oblige

Yours truly, W. T. CASGRAIN.

THE NEW YORK AND BROOKLYN BRIDGE.

The figure on this page representing the cross section of the New York and Brooklyn Bridge, was prepared to accompany the Report which was anticipated from the Chief Engineer, in answer to a resolution of the Board of Trustees made at their last meeting, calling for information from him in reference to changes of plans of the superstructure of the bridge. The anticipated meeting of the Board has not taken place, but as e matter of interest to many of our readers at this time we insert the figure, which explains itself sufficiently, if it be understood that the original plan of the bridge looked only to the passage of ordinary cars, and the height of the main trusses (within which the Pullman cars are there shown) were then but 10 ft. high, on the line of *AA*, instead of 15 ft. as now. The foot-path was on the level of *BB*, and the side trusses were but 8 ft. 8 in., where they are now 10 ft. high, and the main lattice girders, now 2 ft. 8 in. in depth, were then plate girders of but 15 in. in depth. These and other minor changes will indicate the great additional stiffness which has been given to the platform of the bridge, and its consequent increased capacity for irregular loading at the expense of a few hundred additional tons of steel.

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SPUYTEN DUYVIL DISASTER—THE VERDICT.

On the 25th inst., the Coroner's jury rendered the following verdict, which was delivered by the foreman, General Viele:

"As to the responsibility for this calamity the jury find:

"*First*—That George Melius, the rear trainman of the Chicago Express train, was guilty of wilful, deliberate and culpable neglect in not going immediately to the rear of his train a sufficient distance to warn the approaching train, according to the rules of the company, which he had ample time to do; and that said George Melius is directly responsible for the loss of life that followed such neglect.

"*Second*—That George F. Hanford, conductor of the Chicago Express train, in not going in person immediately to the rear of the train to see that the rear trainman did his duty, and in not replacing the rear trainman by another trainman, as directed by the rules of the company, is responsible for the loss of life that followed such neglect of duty.

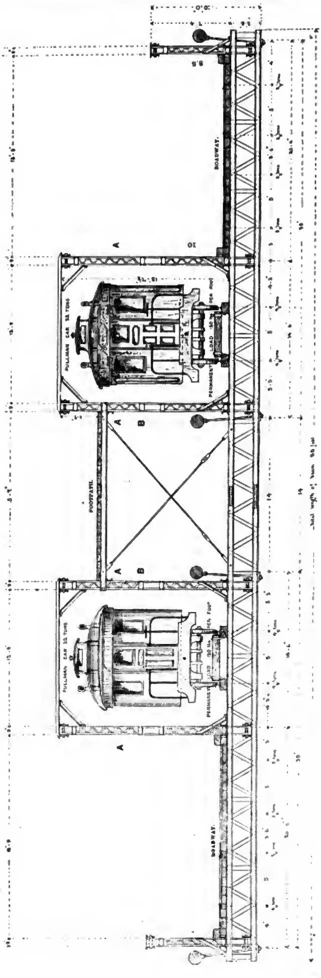
"*Third*—That Edward Stanford, engineman of the leading locomotive, in persistently endeavoring to draw the train after the brakes had been applied, neglected his duty end is responsible for the loss of life which followed such neglect of duty.

"*Fourth*—That Archibald Buchanan, engineman of the locomotive immediately attached to the Chicago Express train, in persistently endeavoring to draw the train after the brakes had been applied, and in neglecting to cut off the escape of oir from the oir-chamber on the locomotive as soon as the brakes were applied, thus depriving himself of the power to release the brakes, neglected his duty and is responsible for the loss of life that followed such neglect. That Frank Burr, engineman of the locomotive of the Tarrytown special train, neglected his duty in not keeping a proper lookout in passing from the Spuyten Duyvil cut, failing for this reason to see the signals of danger in time to check the speed of his train, and is responsible for the loss of life resulting from such neglect.

"*Fifth*—That John M. Toucey, Superintendent of the New York Centrol & Hudson River Railroad Company, in neglecting to provide efficient safeguards against accidents at the most dangeroue part of the road—namely, the Spuyten Duyvil cut—and in formulating a schedule of time for the passage of trains that permitted a rate of twenty miles an hour on a sharp curve through a high, precipitoue cut, in which it is impossible to see more than fifty feet ahead for a distance of 600 ft., is responsible for the loss of life which followed such neglect and such schedule.

"*Sixth*—That the officers and managers of the New York Central & Hudson River Railroad Company, in neglecting to provide suitable implements for the rescue of passengers in danger, and proper means for extinguishing fire on the trains, in not establishing the competency of their employés by proper mental and physical examinatione to test their qualifications for the responsible and critical duties imposed upon them, are responsible for the loss of life thot followed such neglect.

"The jury find that each and every one of the persons named is responsible in his own individuality, no one sharing the responsibility with another; and as a further expression of their opinion, the jury effirm that with their experience of fifty yeers in general management, and with the appliances in general use for the prevention of like disasters, there appears to be no palliation whatever for the criminal carlessness and disregard for



CROSS SECTION OF THE NEW YORK AND BROOKLYN BRIDGE.

human life exhibited by the employés of the company. The conduct of these employés removed this calamity from the chapter of accidents, making the result of destructive agencies at work as much a certainity as the discharge of a piece of artillery. The only surprise is that the slaughter was not greater; it could not well have been less.

"As a still further expression of their opinion on the evidence the jury deems it fitting to express their reprehension of the practice of the promiscuous distribution of free railroad passes during the session of the Legislature, believing it to be demoralizing in its tendency and an incentive to unseemly conduct by encouraging free excursions between the capital and the metropolis. The jury deem it their duty to urge the immediate and thorough protection of the whole line of the Spuyten Duyvil branch road at all the road and street crossings within the city limits.

"The jury regard the use of a cord attached to a valve of the air-brake in the passenger cars as attended with more elements of danger than safety, and as complicating the use of an already complicated appliance, believing that the strap running through the cars and connecting with the engine is a safer reliance against accidents.

"The jury regard the use of candles in lighting the cars to be attended with less danger than oil, and that they answer all necessary purposes. The jury further find that George Melius, George G. Hanford, Archibald Buchanan, Frank Burr, John M. Toucey and the New York Central & Hudson River Railroad Company are guilty of causing the death of Webster Wagner, Park Valentine, Louisa Valentine, Mary L. Brown, J. Albert Richards, Oliver P. Keeley, Francis Marechal and Darling L. Ransom, by criminal means and culpable negligence in the performance of their several duties connected with the said railroad company, in so far as by such inquisition the jury have been able to ascertain.

"Signed: Egbert L. Viele, Charles H. Haswell, John Payser, D. H. McAlpin, Henry J. Davison, L. E. Schneider, W. H. Weightman, Henry Eichling, Francis J. Burke, Edward Haeuser, L. T. Howes, J. Teichman."

NEWSPAPER OPINIONS ON THE VERDICT.

The verdict of the Coroner's jury upon the Spuyten Dayvil disaster is so sweeping as to be absolutely worthless for any public purpose and entirely to defeat its own object, whether its object be public or private. The evidence showed plainly that the brakeman was guilty of gross negligence. The conductor cannot properly be said to have been guilty of negligence at all. He neglected nothing. He did what he supposed to be his duty, and went where he supposed himself to be most needed; and it now appears that he made a mistake. But the verdict in effect asks the public to believe that on a railroad managed with exceptional care and intelligence, on which accidents are very infrequent, two trains were entirely manned by reckless incompetents. The public will decline to believe anything of the kind. It is very well to summon experts on juries called to investigate disasters of this kind. But it ought to be ascertained first that the experts are men not merely of special knowledge but of common sense, and men who are capable of undertaking their work in something approaching a judicial frame of mind.—*N. Y. World.*

Responsibility for an accident may attach to a great many people. In the case of the Spuyten Duyvil accident it appears that the express train was stopped, not by the brakes getting out of order, as was first reported, but by some tipsy passenger tampering with them in the car closet, where means of putting them on is provided for use in case cause of stoppage should be known on the car and not on the locomotive. This person is presumed to be a member of the Legislature, who will probably interest himself in the laws proposed at Albany for preventing railroad accidents. But then the stopping of the train need not have caused an accident, and would not if the brakeman had done his duty and gone back with a danger signal, as the rules plainly prescribe; and so the brakeman is responsible. But probably the brakeman would have gone back far enough if the conductor had ordered him, as the rules prescribed (at least if he had watched him around the corner), and thus the conductor becomes responsible. But if this section of the road had been worked by the block system, as the section but a few miles from it is, then there would have been no approaching Tarrytown train south of Spuyten Duyvil to run into the express; and here we have the company responsible. And each and all are truly responsible.—*R. R. Gazette.*

It is evidently the opinion of the Coroner's jury in the Spuyten Duyvil case that somebody is to blame, though the sweeping generality of their inculpation of almost everybody mentioned in connection with the calamity seems to us likely to lead to about the same result as if they had found the ancient verdict of nobody to blame. They do find, in fact, that it is nobody in particular. It is the brakeman, the conductor, the two engine-drivers of the express, the engine-driver of the other train, Mr. Toucey and the officers and managers of the Hudson River Railroad Company—each of these as to some specific point. Mr. Toucey is held responsible for the loss of life on account of the way the time-table was made out; the company, because there was no implements, such as axes; the Tarrytown engineer, because he did not keep a good lookout, and so on. We are in favor of holding somebody to a distinct responsibility in a case like this; but we believe such a verdict defeats that end. It is held in one sentence that Melius is responsible for neglect of duty; but if the time-table was at fault that lightens, so far as it goes, the fault of Melius; and if Melius did not go far enough to the rear to warn the Tarrytown train, how is the Tarrytown engineer to blame for not seeing him? If he did go far enough to be seen by that engineer, how is he guilty? Both the engine men of the Chicago train are made responsible for the loss of life because they persistently endeavored to go ahead with the brakes applied; but was it the endeavor to go ahead that caused the disaster?—*N. Y. Herald.*

The verdict of the Coroner's jury in the Spuyten Duyvil disaster comes to prove the possible virtue of a system which long since fell into general discredit. It has of late come to be accepted that the Coroner's inquest will do little except to secure a recital under oath of facts long before gleaned by the active agents of the daily press. It is rarely that the readers of the morning papers within 24 hours of a murder or a railway accident do not know as much as after the Coroner has closed his investigation, and equally rarely that they cannot come to a sounder conclusion than is generally embodied in the verdict of the Coroner's jury. But in this case the jury was an exceptionally intelligent and clear-headed set of men; the testimony was very simple, direct and comprehensive, and the result is that a verdict is presented which fixes the responsibility in a manner not to be mistaken. The jury find that Melius, the rear trainman of the Chicago express, was responsible for not giving the proper signal to the Tarrytown train; Hanford, the conductor, for not seeing that the trainman did his duty; the engineers of the Chicago train for trying to draw the train after the brakes had been applied, the engineer of the Tarrytown train for not keeping a proper lookout; Toucey, the superintendent of the road, for neglecting efficient safeguards and for the rapid time required of trains in the Spuyten Duyvil cut, and, finally, the officers and managers of the road in neglecting proper means for the rescue of passengers and the extinguishing of fires, and in not sufficiently testing the competency of their employés. Had the directors and officers of the road made it plain that they regarded the safety of the passengers who had intrusted their lives to them as a consideration above and beyond all others, there could have been no such indifference to that consideration as was shown at Spuyten Duyvil, and as is shown every day of the year on some of the trains of this company. It is, therefore, especially desirable that the officers of the law into whose hands the matter now passes should pay particular attention to those who are highest in authority. We do not know how far the statutes impose penalties for such "neglect" resulting in loss of life as the jury distinctly charge upon the officers and managers of the New York & Hudson River Railroad, but it is essentially necessary that every possible means should be resorted to to bring these gentlemen to a strict account. If it were within the range of the capacity of the law that the more directly responsible of them could be made to see the inside of a prison, a sense of personal accountability would be awakened in the bosoms of all of their class which would add very much to the safety of the millions of railway passengers in our country.—*N. Y. Times.*

It is always desirable to have an emphatic and definite verdict; and in the present instance nobody can justly complain that such a one has not been rendered. We believe it is a long time since the officers and managers of a company have been so pointedly censured; and that those of the Hudson River Company have been thus rebuked, proves that the jury were both conscientious and courageous. Were there any hope of perfect justice being meted out to the parties upon whom this frightful responsibility is fixed, it would be gratifying to know in what that justice would consist. At any rate the conclusions to which the jury has arrived will give general satisfaction, excepting to the culprits themselves and their relatives and friends.—*Evening Telegram.*

MR. VANDERBILT'S FEELINGS.

Mr. Vanderbilt is said to have been greatly shocked by the terrible crash and slaughter on his railroad at Spuyten Duyvil. There was reason why he should. When all the truth comes out, if it ever does, it will be seen that the culpable brakeman, who was so promptly arrested, is not much more than a scapegoat. Economy in running the road was the primary cause of the horror. Had the flagman who was discharged some months ago, to save his paltry $1.50 a day, been retained at his post, the chances are ten to one that the horror would not have happened. A curious thing occurred yesterday at the District Attorney's office. It is part of the District Attorney's duty to keep an eye on the Coroner's inquiry. He was just about to send one of his assistants with the Coroner when a pass, good for one year over any of the Vanderbilt roads, was handed to him. It came from Mr. Vanderbilt's confidential man, Chauncey M. Depew. Mr. McKeon ordered its prompt return. He won't accept favors. If it were against the law for any official to accept a railroad pass, the railroad companies probably would not get off quite so easy as they do.—*Exchange.*

* * *

THE BAILEY FIRE HYDRANT.

The different kinds of fire hydrants now in general use may be divided into three classes, viz.: Those with valves opening with the pressure and current of water, those opening against the same, and gate hydrants. The one which we illustrate to-day belongs to the first class, and, commencing from the bottom, has the following parts: 1. The valve case where connection is made with the main, and containing the valve, drip and all vital parts of the hydrant. 2. The stand-pipe. 3. The stuffing-box plate. 4. The top or cover.

The valve is a piston-valve, closing on a flat, or beveled seat, as preferred. The bottom surface of the valve is hard leather, which, having stood the service of 8 years, is believed to be the best material for the work. The circular surface *D* of the piston is a split bronze ring *B*, fitting loosely on the inner parts of the valve, but springing and fitting closely in the bronze ring, which is driven tight into the valve case. Through the ring *B* in the case and the iron outside of it, there is a drip-hole, and when the valve is closed this drip-hole is uncovered and allows the water to run out of the stand-pipe; but as soon as the hydrant is opened *a quarter of an inch* the drip is closed, and as the water pressure gets within the split drip-ring the greater the pressure the tighter the drip.

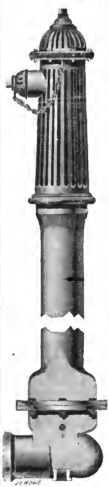


FIG. 1. PERSPECTIVE.

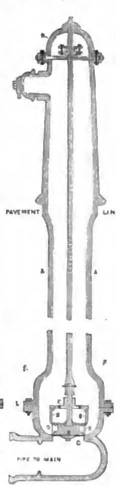
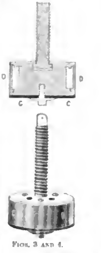


FIG. 2. SECTIONAL.



FIGS. 3 AND 4.

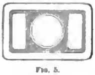


FIG. 5.

THE BAILEY FIRE HYDRANT.

The drip is therefore perfectly positive and perfectly tight—even when the hydrant is open but ¼ in.—a somewhat new feature, since there are hydrants in which the drip is not closed until the valve is nearly wide open, and others where the drip is never closed, unless the pressure in the mains is sufficient to overcome a valve kept open by its own weight. Most of the hydrants used in New York City are provided with the gravity drips, and probably every one when in use is like a leak in a suction pipe. If the pressure is so little that the fire engines have to suck water through the hydrants they also suck air through the drip valves. The valve in the hydrant here illustrated is operated directly by a short brass stem not over 6 in. long, which stem runs in a thread in the brass cap screwed into the top of the valve case, a prolongation of this stem runs into the cover as shown. The valve is shown is Figs. 3 and 4 and the cap *E* in the lower part of Fig. 2. When the valve is opened it rises into the chamber *BB*, sliding up within the brass ring lining said chamber. The water goes up each side as shown in Fig. 5, and passing the valve chamber the two currents unite in the stand-pipe. The area or capacity in the two side ports and stand-pipe is largely in excess of that of the supply-pipe.

In case it is necessary to remove the valve for examination or repairs, this can be done *by one man* and a new valve placed in position in 15 minutes. The cover and stuffing box plate are removed, a socket wrench with gas pipe stem is slipped down over the stem upon the cap in the valve case. This is unscrewed and the stem, cap and valve are all lifted out. This facility for repairs is somewhat in contrast with the use of 2 or 3 men, the gin poles, tackle blocks and levers, which may be seen when a hydrant which unscrews at the base is used. In that case the stand-pipe, weighing several hundred pounds and extending from 4 to 5 ft. below the surface, has to be lifted out, which is more than 1 man can do.

Should the stand-pipe here be broken in any way it does not injure the valve at all or cause it to leak, but a new stand-pipe can be put in place without shutting off the water in the main.

The positive action of the valve and drip, and the ease with which repairs can be made if necessary, commend themselves.

The makers are the Mohawk & Hudson Manufacturing Co., of Waterford, N. Y., who make the Eddy valve also.

◆

CORRESPONDENCE.

THE BEST STUMP-PULLER.

CINCINNATI, Jan. 24, 1882.

EDITOR ENGINEERING NEWS:

Permit me to answer Mr. Fisk's query as to the "best stump-puller" by recommending, for ease, simplicity, thorough work and economy, cartridges of Hercules powder or dynamite.

Take a crowbar, and with it make a hole under the stump large enough to insert a cartridge. Shove the cartridge in, fire the fuse, and retire. The result will be eminently satisfactory. Very refractory stumps may call for two cartridges, but one will usually suffice.

In 1879, during the convention of the American Society of Civil Engineers in Cleveland, I witnessed this method of stump extraction at the factory of the Hercules Powder Co. I was greatly impressed with its advantages, and am glad to have an opportunity of calling attention to it. W. E. M.

ALIGNMENT OF COMPLETED RAILROADS.

BACKWOODS, Canada, Jan. 3, 1882.

EDITOR ENGINEERING NEWS:

I undertake to furnish your correspondent with a method by means of which he can take up the alignment of a railway, the records of which have been lost. Along the straight portions a couple of trials will fix his line for him; by taking the center of his embankment in a number of places, he will, upon prolonging any one set of them, soon hit upon a mean. For curves see "Henck's Field Book for Engineers," page 58, prob. 79; or if he has any case where the intersection angle cannot be found, take a few points as *A B C*, 100 feet apart, measure the deflection angle to them, and a few trials will show him where the center line ought to be; he has then his deflection angle and chord, from which the radius of the curve can be found.

For, let D = deflection angle,
C = chord,
B = radius,

$$\text{Then } R = \frac{\frac{c}{2}}{\sin. D.}$$

Yours, etc., L. L. P.

THE DENVER & NEW ORLEANS RAILROAD.

PUEBLO, COL., Jan. 16, 1882.

EDITOR ENGINEERING NEWS:

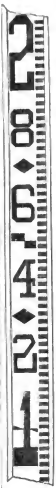
The first party on surveys for the Denver & New Orleans Railroad left Denver on March 18 last under my charge. Since that time many lines and miles of preliminaries have been run; the road located from Denver to this point, about 120 miles, and the earthwork done, with the exception of a little within the city limits of Pueblo. The track is laid out 50 miles from Denver, and bridge-building and track-laying progressing fairly for winter work. If not too much impeded on the Colorado Divide, *i. e.*, between the drainage of the Platte and Arkansas rivers, by heavy snows, the track will probably be laid to this point by April 1. My assistants on construction of the Arkansas River Division have been Mr. E. R. Howe, Mr. S. W. West and Mr. Thomas W. Titcomb. In my party on location south of this point are Mr. A. M. Gibson, transitman; Mr. R. G. Withers, levelman, and Mr. John F. Taylor, Compassman. Mr. W. J. Smith has been in charge of preliminary surveys south of the Arkansas since April last, and is now on the Cimarron, or between that stream and the Canadian River.

The company have opened a fine vein of coal on their property, about 12 miles east of Colorado Springs, and about 4 miles from the main line, the coal branch being very direct, with moderate grades all in the direction of the loaded trains.

With the fervent hope that the NEWS "may live long and prosper," I remain

Yours truly, JOHN S. TITCOMB,
Division and Locating Engineer.

SELF-READING LEVEL RODS.



MINNEAPOLIS & ST. LOUIS RAILWAY,
ENGINEERING DEPARTMENT.
IN CAMP, Dec. 26, 1881.

EDITOR ENGINEERING NEWS:

I have noticed the several designs for self-reading level rods that have been illustrated in the NEWS, and I send you an illustration showing the form designed and used on this road. The advantage of this style consists in the figures being formed of straight lines entirely, and the centre of the figure making the tenth, the top and bottom of the figures show the half-tenths at a glance. This, together with the fact that the thickness of the figures, for the tenths, is one hundredth, reduces the necessity of counting, to determine the hundredths at turning points, to a minimum. The facility of reading will be seen by a slight examination of the diagram. The figures 1 and 2 are to be red on the rods for greater distinctness. In practice our levelers read these rods easily at 1,000 feet, the shape of the figures helping not only to make reading at a distance easy but also doing away with errors through getting figures confused by wrong reading.

It is seen that these rods are adapted to the use of a target if desired, and it is our practice to use a target on turning points, and thus check the level reading.

The plan and elevation show the construction, which does not differ materially from the usual form for self-reading rods.

Respectfully,
GEO. L. WILSON.

[Some time since we published accounts of two self-reading level rods which were in use, and had many earnest advocates of their efficiency. We now present the third. Our readers can form their own estimates of the relative merits of each.]

THE STANDARD METRIC CHAIN.

PROVIDENCE, R. I., Jan. 20, 1882.

EDITOR ENGINEERING NEWS:

Several communications have recently appeared in your columns concerning the use of the metric system in civil engineering, from which it appears that a great diversity exists in the application of the system, already resulting in much confusion; and the question is asked, What should be the length of the standard metric chain?

The object of all operations involving the use of the metric system is to measure quantity in terms of some one of a certain series of units of measure which are decimally related to one another, and to do this in the simplest manner.

A standard series of measures has been adopted for the measurement of quantities of different magnitudes, by which the measurement is performed without any unnecessary use of fractions, and therefore in the simplest manner. The measures of this series are determined by the following general principles:

I. A measure may consist of a single metric unit of length, capacity or weight, or may be a multiple of some such unit.

II. Each multiple measure shall consist of a whole number of the metric unit next smaller than itself. Consequently, each multiple measure may be expressed in terms of every metric unit smaller than itself without the use of fractions.

III. Each multiple measure shall be competent to measure without the use of fractions, the metric unit next larger than itself, and consequently every metric unit larger than itself.

Since the successive metric units are related to each other by a ten-fold ratio, it follows that every multiple measure must consist of either two or five metric units next smaller than itself, and the complete series of measures, whether of length, capacity or weight, consists of the metric units themselves, together with the half and double of each.

It should always be kept in mind, however, that quantity should never be stated in terms of the multiple measure, but always in terms of the metric units; the multiple measures being only intended to simplify the mechanical process of measuring.

The series of standard linear measures is shown in the following tables:

THE STANDARD METRIC MEASURES OF LENGTH.

NAME.	Length in meters.	REMARKS.
Half-decimeter......	0.05	Used by machinists and others on small work. Edges are divided into millimeters and fifths, millimeters and halves, or millimeters. The numbering is in centimeters.
Decimeter...........	0.10	Ditto.
Double-decimeter..	0.20	Ditto.
Half-meter..........	0.50	A convenient measure for carpenters and others on bench work. Divided to millimeters and numbered in centimeters.
Meter.................	1.00	Made in various forms and suitable for a great variety of uses. Divided to millimeters or centimeters and halves, or centimeters. Usually numbered in centimeters.
Double-meter.......	2.00	A convenient rod or tape for measuring objects of moderate size. Divided and numbered like the meter.
Half-dekameter....	5.00	A rod or tape for measuring objects of larger size. Seldom used.
Dekameter..........	10.00	Tape or chain for land surveying and civil-engineering. The chain has *five* links to the meter, and is marked at each meter.
Double-dekameter..	20.00	Ditto. Better adapted for measuring smooth land. The chain has *five* links to the meter, or 100 links altogether, and is marked at each meter.

Similar tables, showing the standard metric weights and capacity measures, exist, but are foreign to the purpose of this communication.

This series of standard measures was adopted many years ago, and is used in France and other metric countries. In France it is prescribed by law.

A chain of 25 meters violates the second general principle, inasmuch as its length is 2½ *dekameters*; 25 being a more complex number than 20, it is intrinsically a less convenient implement to use.

A chain of 30 meters violates the third general principle, since it is impossible to lay off a hektometer or kilometer by means of it without an annoying use of fractions.

The Gunter 4-rod chain is widely known, and is extensively used in civil engineering and land-surveying both in this country and in England. Its length, which is $20\frac{12}{100}$ meters, shows that the 20-meter chain is by no means unsuited to field work on account of its absolute length.

When using the 20-meter chain it should be constantly borne in mind that the terms "chain" and "link" have no significance in the metric system, except as designating an implement and its parts. They are never used to indicate units of length.

It should also be remembered that the chain and its links are each double units, and that distances should never be expressed in terms of them, but always in terms of some metric unit.

With such a chain the stations of a railroad would naturally be placed 20 meters apart. The numbering of the stations and the record kept of the survey should be of such a character that the distance between any two points may always be obtained by a single subtraction. This may be done by marking upon the stakes their distance, from the initial point either in *meters* or in *dekameters*. Either method is entirely legitimate; but it is important that one or the other should be adopted uniformly.

Fewer figures are required when the stakes are marked in *dekameters*, and this method seems to the writer to be more in keeping with the habits of thought of the American engineer.

Upon ordinary ground the stations would be marked with the even numbers, as 0, 2, 4, 6, 8, 10, etc., the hektometers appearing as multiples of 10, and the kilometers as multiples of 100. Upon rough ground the stakes would be set 10 meters apart, and the numbering would embrace all the numbers, as 11, 12, 13, 14, etc. Fractional stations would seldom be required in cross-sectioning.

The two methods of marking the stakes are contrasted in the following table:

Distance of each station from the initial point in meters.	MARKING OF THE STAKES.	
	Method in meters.	Method in dekameters.
5,720.00	5,720.00	572
5,740.00	5,740.00	574
5,760.00	5,760.00	576
5,780.00	5,780.00	578
5,800.00	5,800.00	580
5,810.00	5,810.00	581
5,820.00	5,820.00	582
5,825.64	5,825.64	582+5.64

The unnecessary complication caused by the use of the 25 meter chain and an imperfect system of numbering the stations on some of the Mexican railways, has already been illustrated in your columns, and requires no further comment.

CHARLES H. SWAN, C. E.,
Chairman Metric Bureau Committee on Manufactures.

THE METRIC SYSTEM FOR RAILROADS.

NEW YORK, Jan. 12, 1882.

EDITOR ENGINEERING NEWS:

I notice in Mr. Lowe's communication relative to the use of the Metric System on the Mexican Railroad, page 3, of the 7th inst., that a chain 25 meters long is used and every meter is marked with a tag with the appropriate numbers stamped thereon, and that some of the chains have 125 links each, two decimeters long, while others have 100 links each, 2.5 decimeters long; also that the plus distance is given in meters, thus 28 + 12 means 28 stations plus 12 meters, the total distance equals 712 meters. Now in view of the fact that many valuable tables in our field books for engineers are based on a chain having 100 units of length, it would be more convenient to use a chain, whatever its length may be, of 100 links, and to mark every ten links with a tag, the same as in the 100-foot chain, and then note all, plus distance by the number of links the distance measures. The foregoing example, 28+12, would be noted as 28+48 or 28.48; the 12 meters would come at the forty-eighth link, and $\frac{2848}{4}$ = 712 meters, same as before. A chain of 20 meters would be convenient, particularly in estimating earth-work from average end areas (estimating earth-work from average end areas instead of the prismoidal formula is a common practise among engineers); take, for example, the following field-notes for an embankment with a road-bed of 4 meters, slope 1½ to 1. I have assumed the road-bed to be 4 meters for the reason that if the metric system were in use in this country the width of a single track road-bed would generally be, in all probability:

For embankment, 4 meters = 13.12 ft.,
" excavation (earth., 6 meters = 19.68 ft.

These numbers, 4 and 6, are handy ones to use in calculating end areas of cross-sections where the center and two side heights and the distance out are given, as in the following notes:

Road-bed, 4 meters. Slope, 1½ to 1.
Length of station, 20 meters.

Stations.	Left.	Center.	Right.	Embankment.	
				Sq. meter.	Cu. meter.
24	−4.10 8.15	−2.24	−3.16 6.74	23.94	......
25	−3.94 7.91	1.18	−2.02 6.38	15.29	392.3
26	−1.24 3.86	−2.14	2.18 5.27	13.19	74.0

For example take the cross-section at station 24 and apply the old rule, viz:

Add the two side heights and multiply by one-fourth the road-bed (in this case one-fourth the road-bed is unity) (4.10+1.16)×1=7.26 sq. meters, then multiply the sum of the distance out by half the centre height $(8.15+6.74)\times\frac{2.24}{2}=16.68$ (the nearest hundredth), and add the two results together, 16.68+7.26=23.94 sq. meters, the total area for this station. Having calculated the areas for the three cross-sections, we now proceed to obtain the cubic meters. Add the areas for stations 24 and 25 and put the sum in the column *cubic meters*, moving the decimal point one figure to the right, in like manner add the areas for 25 and 26 and multiply the same by .26 and place the result in the column of cubic meter. Now, if instead of a 20 meter chain, one of 25 meters had been used, then we should increase the amounts in the cubic meter column by one-fourth.

In comparing the number of figures and in calculating cross-section areas where hundredths are used in the metric system and tenths in the foot, it will be found that for distances ranging from 1 ft. to 3.28 ft. and from 10 ft. to 32.8 ft. the same number of figures will be used in either system, but from 0 to 1 ft. and from 3.28 to 10 ft. more figures will be used in the metric system.

In curvature let us consider the chain to subtend on the chord an angle of 1° for a 1° curve, the same as in the foot system, then the radius would equal 5,730 links instead of that many feet, and if the chain is 20 meters long, then each link equals 2 meters and 5,730 links equal 1,146 meters.

20 meters = 65.6 ft., = ⅔ of 100, nearly.
Let M° = curvature in the metric system.
and F° = " " " foot "

Then will the following formulas give a close approximate of the relative value of the two systems:

$$F^\circ = 1\tfrac{1}{2} M^\circ$$
$$M^\circ = \tfrac{2}{3} F^\circ$$

For instance if 6° is the maximum curvature allowed in the foot system, then its equivalent in the metric system would be $\frac{2}{3} \times 6^\circ = 4^\circ$.

In conclusion, I will state that if the metric chain has 100 links, and we consider each link in the light of a foot, we may use in connection with it, and with equal facility, the many valuable tables that have been constructed for the 100-foot chain; and here I may state that a most excellent table has been devised for the use of the locating engineer by Wm. F. Shunk, and is to be found in his new book, "The Field Engineer;" it gives the lengths of chords, versed sines, external secant and tangent for a 1° curve for every even minute up to 90°. I have used this table for the past six months on location, and know from experience it is of great value, and I think it can be used just as readily in the metric system, in the manner suggested, as in the foot system.

Respectfully, JOHN WATERHOUSE.

ASPHALT PAVING—ITS CLEANLINESS, CHEAPNESS AND COMFORTABLENESS.

[From the Philadelphia Record, Jan. 19, 1882.]

WASHINGTON, D. C., June 7, 1881.—H. W. Pitkin, Esq., Chairman of the sub-committee of the Executive Committee of One Hundred, Philadelphia, Pa.—Dear Sir: I have had the honor to receive your letter of the 4th instant, making inquiries in regard to the asphalt pavements of this city, and to reply:

First. As to comparative first cost of asphalt and granite-block street pavements.

Granite-block pavements laid in 1880 in this city cost $1.79 per square yard. Those laid in 1879 $1.92 per square yard.

Asphalt pavements laid here in 1880 cost $1.85 per square yard. In 1879 cost $1.47 per square yard.

Second. Annual costs of repairs of the asphalt pavement on Pennsylvania avenue, the principal street of Washington, has been for the Neufchatel pavement 2½ cents per square yard. For that laid on same street by other contractors, 1½ cents per square yard. These pavements have been in use now about 4 years.

Other bituminous concrete pavements of various kinds, principally coal tar, have been laid in this city since 1871 to the extent of 741,000 square yards. Their average annual repairs have cost 8½ cents per square yard. They are not so good or durable as the asphalt pavements laid in the last four years.

Macadam pavements in Paris are being diminished in extent, being replaced by others less expensive in maintenance. They are not liked here, except for the suburbs, where there is little heavy travel. They cost for repairs on the most traveled streets $1.93 per square yard. The average annual cost for repairs is 37 cents per square yard.

Paris stone block pavements are made of sandstone; cost $2.38 to $3.23 per square yard for construction and 10½ cents per square yard per annum for repairs.

Asphalt pavements in Paris cost per square yard $2.17 to $3.22 and per year for repairs and replacing each year $\frac{1}{5}$ of the pavements laid 22 cents per square yard.

There is more asphalt and bituminous concrete pavement in this city than in any city in the world. It was introduced at first in many streets against strong prejudices of the dwellers on such streets. Stone pavements, wooden pavements and Macadam pavements were preferred, and were laid to a great extent.

Now, the city authorities lay down any other than an asphalt pavement only when compelled by economy, which, in some cases, prescribes the use of Macadam or gravel and stone blocks where traffic is believed to be too heavy for the asphalt; and they find the residents of such streets wherever anything but asphalt is laid down making vigorous protests against their operations.

Since 1871 there have been laid here of wood pavements 1,188,597 square yards, costing $4,003,744, and covering 50 miles of streets.

On the 1st of July, 1880, there remained in the city only 509,481 square yards of this wood pavement, most of it impassable without danger to wheels and springs.

The city contained on 1st July, 1880, of concrete unfaced with asphalt or coal tar:

	Miles.
Pavements	40.66
Stone block	14.87
Rough stone	18.04
Macadam	7.45
Gravel	31.31
Wood	22.10
Unimproved streets	95.62
Total	230.05

I have no doubt that the wear and tear of horses and carriages on a good asphalt pavement, such as that of Pennsylvania avenue, in this city, is very much less than on any other pavement in use here.

I think a carriage used on mud roads will last ten times as long as if used on the streets of Philadelphia, with which I am familiar, having lived there from infancy to manhood, and having in visits of late years found no improvement, but rather a worse condition than existed 50 years ago in that city.

Third. The asphalt would, in my opinion, certainly answer for all your streets not subjected to heavy traffic. But as this heavy traffic—and it is very heavy in Philadelphia—will abandon all the cobble pavements to seek the newly asphalted streets for the sake of the easier draught, the freedom from jolting and the greater comfort for horse and man, I do not see how this traffic can be kept off any principal street in Philadelphia. I think that the first street asphalted will be crowded at once, and that the heavily-loaded vehicles will drive off the light pleasure traffic.

In your narrower streets, alleys, and small streets which, like many of those in Philadelphia, do not follow continuous lines, but are offset at many street crossings, the asphalt will give you a clean, wholesome pavement. Every summer shower washes its surface perfectly clean, and if the fall is good cleans even the gutters. Used on those streets and in alleys it will be a great economy and have a great sanitary influence.

I have lived and ridden and driven in this city during the execution of all its street improvements. There is no comparison in comfort between any other pavement and one of asphalt for those who ride or drive either in light carriages or in heavy loaded carts and wagons and for the residents on the streets, and I am of opinion that while the cost of repair of asphalt under heavy traffic would be much greater than such cost in this city at present; that considering the saving in cleanliness, comfort and health to man, and the saving in cost of horseflesh and of repairs of wheels and springs, it will be worth while to lay down a strong asphalt surfaced concrete payment for your heaviest traffic, and to compare its first cost and its actual annual cost for repairs and *renewal* with the cost and duration of your present street pavements, and that it is probable that taking into account the saving of horseflesh, of wear and tear of all vehicles and of body and mind, it will be found best to adopt the asphalt pavements generally.

It will be necessary to make frequent renewals of the wearing surface, but this is cheap. Any Philadelphia block, laid on a good foundation of concrete thick enough not to give way under the weight of loaded truck wheels, can be resurfaced in twenty-four hours, and by doing the work at night I believe that it can be done without stopping the daily commerce of the streets.

Here the usual foundation is six inches of concrete of hydraulic cement, sand and broken stone. Possibly in Philadelphia there may be streets which would need twelve inches of such foundation, well set before being opened to traffic. But in the end I believe this would be fully worth its cost.

I have just obtained a proof of the annual report of Lieutenant F. V. Greene, United States Corps of Engineers, from which most of the figures and quantities in this letter are quoted. It is probably the very best, as it is the most recent, paper on the subject of these pavements.

I am, very respectfully, your obedient servant,
M. C. MEIGS,
Quartermaster General, Brevet Major Gen. U. S. A.

◆

TEXAS PINERIES.—The long-leaved pine area in Texas is located in the eastern portion of the State, commencing about 50 miles from the Gulf of Mexico. The short-leaved loblolla and yellow-pine area, with oak and other hardwood timber mixed, lies west of the long-leaved pine region, extending from 50 miles north of Galveston northward to the Red River, about 350 miles long by 100 to 120 miles wide. The region from which merchantable pine has been taken along the margin of some of the streams is comparatively insignificant, showing that the lumber trade of the Lone Star State is in its earliest infancy, and will be something immense in future years of manhood, when 67,000,000,000 of merchantable pine lumber shall have been stripped from her soil.

LIST OF WATER-WORKS

IN THE UNITED STATES AND CANADA, AS FAR AS KNOWN, JANUARY, 1882.

The first List of Water-Works was published by J. J. R. Croes, C. E., in 1876, for the Centennial Commission of the American Society of Civil Engineers. In 1877 to 1881 Edward Prince, C. E., of Quincy, Illinois, published several editions of revised Lists, compiled by him by great perseverance. This List is based upon his last one, with such corrections and additions as have been discovered during the past year. There are no water-works in several towns included in former lists.

Private enterprises are marked thus *.

- ALABAMA:
  - Birmingham,*
  - Huntsville,
  - Jacksonville,
  - Mobile,*
  - Montgomery.*
- ARIZONA:
  - Prescott,
  - Tombstone.*
- ARKANSAS:
  - Little Rock.*
- CALIFORNIA:
  - Anahaimo,
  - Columbia,
  - Dutch Flat,
  - Gilroy,*
  - Grass Valley,
  - Los Angeles,*
  - Marysville,*
  - Modesto,
  - Mission San Jose,
  - Nevada City,
  - Oakland,*
  - Petaluma,*
  - Placerville,
  - Red Bluff,
  - Sacramento,
  - Santa Barbara,*
  - San Francisco,*
  - San Jose,*
  - San Quinlan,
  - San Rafael,*
  - Salinas City,
  - San Diego,
  - Stockton,
  - Santa Cruz,
  - Vallejo,*
  - Watsonville,
  - Washington, Yolo Co.,
  - Woodford, Yolo Co.,
  - Yreka.
- COLORADO:
  - Bodie,
  - Boulder,
  - Caribou,
  - Canon City,*
  - Central City,*
  - Colorado Springs,
  - Denver,*
  - Fair Play,
  - Golden,
  - Gunnison,
  - Leadville,*
  - Pueblo,
  - Silver Cliff,
  - Silver City,
  - Trinidad.*
- CONNECTICUT:
  - Ansonia,*
  - Bethel,
  - Birmingham,*
  - Bridgeport,*
  - Danbury,
  - Greenwich,
  - Hartford,
  - Meriden,
  - Middletown,
  - Milford,
  - New Britain,
  - New Haven,*
  - New London,
  - New Milford,
  - Norwalk,
  - Norwich,
  - Rockville,*
  - South Norwalk,
  - Stamford,*
  - Stonington,
  - Wolcottville,*
  - Waterbury,
  - Winsted.
- DAKOTA TERR.:
  - Deadwood,
  - Fargo.
- DELAWARE:
  - Dover,
  - New Castle,*
  - Wilmington.
- DISTRICT OF COLUMBIA:
  - Washington.
- FLORIDA:
  - Jacksonville.
- GEORGIA:
  - Atlanta,
  - Augusta,
  - Columbus,
  - Macon,*
  - Rome,
  - Savannah.
- IDAHO TERRITORY:
  - Silver City.
- ILLINOIS:
  - Alton,*
  - Bloomington,
  - Cairo,
  - Charleston,
  - Chicago,
  - Decatur,
  - De Kalb,
  - Dixon,
  - Elgin,
  - El Paso,
  - Evanston,
  - Hyde Park,
  - Jacksonville,
  - Joliet,
  - Lakeview,
  - Litchfield,
  - Moline,
  - Oregon,
  - Paris,
  - Pekin,
  - Peoria,
  - Quincy,*
  - Riverside,
  - Rockford,
- ILLINOIS:
  - Rock Island,
  - Springfield,
  - Sterling,
  - Sycamore,
  - Waukegan.
- INDIANA:
  - Attica,
  - Brazil,
  - Brookville,
  - Columbus,
  - Connersville,
  - Evansville,
  - Fort Wayne,
  - Indianapolis,*
  - Kokomo,
  - LaFayette,
  - Laporte,
  - Logansport,
  - Madison,
  - Marion,
  - Michawakee,
  - New Albany,*
  - New Carlisle,
  - Peru,
  - South Bend,
  - Terre Haute,*
  - Union City,
  - Vincennes,
  - Washington.
- IOWA:
  - Anamosa,*
  - Atlantic,
  - Burlington,*
  - Cedar Rapids,
  - Clinton,*
  - Council Bluffs,*
  - Davenport,*
  - Decorah,
  - Des Moines,*
  - Dubuque,*
  - Fort Dodge,
  - Keokuk,*
  - Lyons,*
  - Marengo,
  - Marshalltown,
  - Monticello,
  - Mt. Pleasant,
  - Muscatine,*
  - Oskaloosa,
  - Ottumwa,*
  - State Centre.
- KANSAS:
  - Abilene,
  - Atchison,
  - Blue Rapids,
  - Emporia,
  - Topeka.
- KENTUCKY:
  - Bowling Green,
  - Covington,
  - Frankfort,
  - Henderson,
  - Louisville,*
  - Maysville,
  - Newport,
  - Owensboro,
  - Pleasant Hill.
- LOUISIANA:
  - New Orleans.*
- MAINE:
  - Auburn,*
  - Augusta,*
  - Bangor,
  - Biddeford,*
  - Houlton,
  - Lewiston,
  - Portland,*
  - Rockland,*
  - Waterville.
- MARYLAND:
  - Annapolis,*
  - Baltimore,
  - Cumberland,*
  - Frederick,
  - Frostburg,
  - Hagerstown,
  - Morganza.
- MASSACHUSETTS:
  - Adams,
  - Agawam,*
  - Amherst,
  - Arlington,
  - Athol,*
  - Attleboro,
  - Beverly,
  - Boston,
  - Brighton,
  - Brockton,
  - Brookline,
  - Cambridge,
  - Charlestown,
  - Cheshire,
  - Chicopee,*
  - Chicopee Falls,
  - Concord,
  - Danvers,
  - Dedham,
  - East Hampton,
  - East Saugus,
  - Everett,
  - Fall River,
  - Fitchburg,
  - Gardner,*
  - Great Barrington,*
  - Greenfield,
  - Greenville,
  - Haverhill,*
  - Hingham,*
  - Holyoke,
  - Kingston,*
  - Lawrence,
  - Lee,
  - Lenox,*
- MASSACHUSETTS:
  - Leominster,
  - Lincoln,
  - Lowell,
  - Lynn,
  - Malden,
  - Medford,
  - Melrose,
  - Methuen,
  - Marblehead,
  - Middleboro,
  - Milford,
  - Natick,
  - Nantucket,*
  - New Bedford,
  - Newton,
  - North Adams,
  - North Bridge,
  - Northampton,
  - Orange,*
  - Peabody,
  - Pittsfield,
  - Plymouth,
  - Reading,
  - Salem,
  - Shelburn Falls,
  - Somerville,
  - South Adams,
  - So. Hadley Falls,
  - South Lee,*
  - Springfield,
  - Stockbridge,*
  - Taunton,
  - Warren,
  - Waltham,
  - Wakefield,*
  - Westborough,
  - West Brookfield,*
  - Westfield,
  - West Springfield,*
  - Winchester,
  - Woburn,
  - Worcester.
- MICHIGAN:
  - Allegan,
  - Alpena,
  - Ann Arbor,
  - Bay City,
  - Big Rapids,
  - Cadillac,
  - Constantine,
  - Detroit,
  - East Saginaw,
  - Grand Haven,
  - Grand Rapids,
  - Holly,
  - Ionia,
  - Jackson,
  - Kalamazoo,
  - Marquette,
  - Muskegon,
  - Niles,*
  - Plainfield,
  - Plainwell,
  - Port Huron,
  - Portland,
  - Saginaw,
  - St. Louis,
  - Tecumseh,
  - West Bay City.
- MINNESOTA:
  - Mankato,
  - Minneapolis,
  - St. Paul,*
  - Stillwater,
  - Winona.
- MISSISSIPPI:
  - Columbus.
- MISSOURI:
  - Carthage,
  - Hannibal,*
  - Kansas City,*
  - Sedalia,
  - St. Joseph,*
  - St. Charles,*
  - St. Louis,
  - Joplin.
- NEBRASKA:
  - Omaha,*
  - Nebraska City,
  - Grand Island.
- NEVADA:
  - Austin City,
  - Eureka,*
  - Gunnison,*
  - Gold Hill,*
  - Hamilton,
  - Pioche,*
  - Virginia City.*
- NEW HAMPSHIRE:
  - Bethlehem,
  - Claremont,*
  - Concord,
  - Dover* (3 co.'s),
  - Farmington,
  - Great Falls,
  - Keene,
  - Manchester,
  - Nashua,*
  - Plymouth,
  - Portsmouth.*
- NEW JERSEY:
  - Bergen,
  - Bloomfield,
  - Bridgeton,
  - Bordentown,*
  - Burlington,
  - Camden,
  - Cape May,
  - Elizabeth,*
  - Flemington,
  - Hackensack,*
- NEW JERSEY:
  - Hackettstown,
  - Hoboken,*
  - Jersey City,
  - Lambertville,*
  - Long Branch,
  - Millville,*
  - Morristown,*
  - Mt. Holly,*
  - Newark,
  - New Brunswick,
  - Passaic,*
  - Paterson,*
  - Perth Amboy,*
  - Rahway,
  - Salem,
  - Trenton.
- NEW YORK:
  - Albany,
  - Amsterdam,
  - Andes,
  - Attica,
  - Auburn,*
  - Avon,*
  - Ballston Spa,
  - Batavia,
  - Bayside,
  - Binghamton,
  - Brooklyn,
  - Buffalo,
  - Canajoharie,
  - Chateaugay,
  - Cohoes,
  - College Point,
  - Cooperstown,*
  - Corning,*
  - Dansville,
  - Delhi,*
  - Dunkirk,*
  - Edgewater,
  - Ellenville,
  - Elmira,*
  - Flushing,
  - Flatbush,
  - Fort Edward,*
  - Fredonia,
  - Garden City,*
  - Geneseo,
  - Geneva,*
  - Glens Falls,
  - Gloversville,
  - Goshen,
  - Gouverneur,*
  - Hudson,
  - Ithaca,*
  - Jamestown,*
  - Johnstown,
  - Kingston,
  - Leroy,
  - Lockport,*
  - Long Island City,
  - Lyons,
  - Malone,
  - Medina,
  - Middletown,
  - Newburg,
  - New Brighton,
  - New Hartford,
  - New York City,
  - Niagara Falls,*
  - Norwich,
  - Ogdensburg,
  - Oswego,*
  - Owego,*
  - Peekskill,
  - Port Byron,
  - Port Jervis,*
  - Port Richmond,
  - Potsdam,
  - Poughkeepsie,
  - Prospect Park,
  - Plattsburgh,
  - Richfield Springs,
  - Rochester,
  - Rome,
  - Saratoga Springs,
  - Schenectady,*
  - Suspension Bridge,
  - Susquehanna,
  - Syracuse,*
  - Tarrytown,
  - Tonawanda,
  - Troy,
  - Utica,*
  - Walton,*
  - Whitehall,
  - Warwick,
  - Warsaw,*
  - Watertown,
  - Waverly,
  - West Troy,*
  - Yonkers.
- NORTH CAROLINA:
  - Fayetteville,
  - Wilmington,*
  - Salem.
- OHIO:
  - Akron,*
  - Alliance,
  - Bellaire,
  - Bellevue,
  - Canton,
  - Cincinnati,
  - Cleveland,
  - Columbus,
  - Crestline,
  - Dayton,
  - East Liverpool,
  - Elyria,
  - Findley,
  - Galion,
  - Hamilton,
  - Ironton,
  - Lancaster,
- OHIO:
  - Lagona,
  - Mansfield,
  - Massillon,*
  - Middletown,
  - New Lisbon,
  - Norwalk,
  - Piqua,
  - Portsmouth,
  - Salem,
  - Sandusky,
  - Sidney,
  - Springfield,
  - Steubenville,
  - Tiffin,
  - Toledo,
  - Urbana,*
  - Wadsworth,
  - Wellsville,
  - West Cleveland,
  - Wooster,
  - Youngstown,
  - Zanesville.
- OREGON:
  - Portland,*
  - Salem,
  - The Dalles.
- PENNSYLVANIA:
  - Allegheny,
  - Allentown,
  - Altoona,
  - Archbald,*
  - Ashland,
  - Beaver Falls,*
  - Bradford,
  - Bedford,
  - Bellefonte,
  - Bethlehem* (2 co.'s),
  - Berwick,*
  - Birmingham,
  - Bloomsburg,
  - Blairsville,
  - Boyerstown,
  - Bristol,*
  - Butler,
  - Carbondale,
  - Carlisle,*
  - Catasauqua,
  - Chambersburg,
  - Chester,
  - Clarion,
  - Coatesville,
  - Columbia,*
  - Connemaugh,
  - Conshohocken,*
  - Corry,
  - Crawfordsville,
  - Danville,
  - Downingtown,*
  - Doylestown,
  - Dunmore,
  - Easton,*
  - Ebensburg,
  - Ephrata,
  - Erie,
  - Franklin,*
  - Germantown,
  - Gettysburg,
  - Hamorton,
  - Hanover,
  - Harrisburg,
  - Hazelton,*
  - Hollidaysburg,
  - Honesdale,
  - Huntington,
  - Jamestown,
  - Johnstown,*
  - Kennett Square,
  - Kittanning,
  - Lancaster,
  - Lansford,*
  - Lebanon,*
  - Lewistown,
  - Lockhaven,
  - Louella,*
  - Mahanoy City,*
  - Mauch Chunk,*
  - Meadville,*
  - Mechanicsburg,
  - McKeesport,
  - Media,
  - Milford,*
  - Minersville,*
  - Monongahela,
  - Mt. Joy,
  - New Brighton,
  - Norristown,*
  - Oil City,
  - Oxford,
  - Parker City,
  - Philadelphia,
  - Phoenixville,
  - Pittston,*
  - Pittsburgh,
  - Plymouth,*
  - Pottstown,*
  - Pottsville,*
  - Providence,*
  - Reading,
  - Renovo,
  - Reynoldsville,
  - Salem,
  - Sewickley,
  - Scranton,*
  - Shamokin,*
  - Sharon,
  - Shenandoah,
  - Slatington,
  - South Bethlehem,*
  - Stroudsburg,*
  - Summit Hill,*
  - Susquehanna,*
  - Tamaqua,
  - Tioga.
- PENNSYLVANIA:
  - Titusville,
  - Towanda,
  - Tunkhannock,*
  - Tyrone,
  - Westchester,
  - West Pittston,
  - Wilkes Barre* (2 Cos.),
  - Williamsport* (2 Cos.),
  - York,
  - Youghiogheny.*
- RHODE ISLAND:
  - Bristol,
  - Central Falls,
  - East Providence,
  - Newport,*
  - Pawtucket,
  - Providence.
- SOUTH CAROLINA:
  - Charleston,
  - Columbia.*
- TENNESSEE:
  - Chattanooga,*
  - Clarksville,*
  - Columbia,
  - Knoxville,
  - Memphis,*
  - Nashville.
- TEXAS:
  - Austin,*
  - Dallas,*
  - Dennison,
  - Galveston,
  - Houston,
  - San Antonio,*
  - Sherman,
  - Waco.*
- UTAH:
  - Salt Lake City,
  - Park City,
  - Logan City.
- VERMONT:
  - Bellows Falls,
  - Brandon,
  - Burlington,
  - Fair Haven,
  - Hyde Park,*
  - Rutland,
  - St. Albans,
  - St. Johnsbury,
  - Vergennes,
  - Windsor,
  - Worcester.
- VIRGINIA:
  - Alexandria,*
  - Danville,*
  - Fredericksburg,
  - Lexington,
  - Lynchburg,
  - Norfolk,
  - Petersburg,
  - Richmond,
  - Staunton,
  - University of Virginia,
  - Winchester.
- WASHINGTON TERRITORY:
  - Olympia,
  - Seattle,
  - Vancouver,
  - Walla Walla.*
- WEST VIRGINIA:
  - Martinsburg,
  - Parkersburg,
  - Wheeling.
- WISCONSIN:
  - Beloit,
  - Fond du Lac,
  - Janesville,
  - Kenosha,
  - La Crosse,
  - Madison,
  - Milwaukee,
  - Prairie du Chien,
  - Racine,*
  - Sparta.
- CANADA:
  - Barrie,
  - Berthier,
  - Brampton,
  - Brantford,*
  - Clifton,*
  - Collingwood,
  - Dundas,*
  - East London,
  - Goderich,
  - Guelph,
  - Halifax, N. S.,
  - Hamilton,
  - Kingston,
  - London,
  - Mitchell,
  - Montreal,
  - Ottawa,
  - Owen Sound,
  - Parkdale,
  - Quebec,
  - Sarnia,
  - Seaforth,
  - Sorel,
  - St. Catharines,
  - St. Cunegonde,
  - St. Gabriel,
  - St. Thomas,
  - St. John, N. B.
  - Sherbrooke,
  - Three Rivers,
  - Toronto,
  - Truro,
  - Walkertown,
  - Windsor,
  - Winnipeg,
  - Wingham,
  - Woodbridge,
  - Yorkville,
  - Yarmouth,

STATISTICS OF 11 TOWNS SUPPLIED BY PUMPING INTO STAND-PIPE.

Name of Town.	State.	Index to Engineering News.			Population.	First Water-Works Built.	Present Works Begun.	Cost.	Remarks.	Bonded Debt.	Year of Returns.	Daily Average Consumption in Gallons.	Yearly Cost of Maintenance.	Yearly Revenue.	Miles of Pipe.	No. of Taps.	No. of Fire Hydrants.	Head in Feet.	No. of Meters.	Ownership.
		Index No.	Date.	Page.	1880.															
Chicago	Ill.	lv.	March 26	122	503,304	1840	1854	$8,802,725.10		$3,955,000.00	1880	57,381,376	$248,907.07	$920,785.16	455.4	67,949	3,361	101.5	2,113	City.
New Orleans	La.	x.	April 23	163	216,140	1836	1879	2,334,382.16		320,000.00	April, 1881	8,947,229	54,651.73	95,937.20	15.5	11,968	1,250	60.0		Company.
Toledo	Ohio	xlix	July 30	305	50,143	1873	1880	1,145,478.62	Including interest.		Dec. 31, 1880	3,262,000	20,777.35	28,919.18	46.87	1,616	349	260.0	85	City.
Charleston	S. C.	li.	Aug. 6	311	49,999	1821	1880			400,000.00		200,000			15			90.0		Company.
Fall River	Mass.	xxix	July 2	234	49,006	1870		1,514,438.67	Except interest.	1,700,000.00	Dec. 31, 1880	1,357,319	15,526.62	114,706.38	52.05	2,685	537	180.0	1,583	City.
Savannah	Ga.	cxxxvii	Nov. 12	459	30,681	1854		300,000.00		198,000.00	Dec. 31, 1880	2,400,000	11,000.00	32,000.00	22.00		257	130.0		City.
Augusta	Ga.	cxxxviii	Nov. 19	468	23,023	1828	1859	361,432.00			Dec. 31, 1880	2,400,000	6,796.85	10,833.23	21.61	1,650		106.3		City.
Bloomington	Ill.	cxlix	Dec. 3	488	17,184	1875		122,000.00		75,000.00	Dec. 31, 1880	400,000	5,426.60	7,613.91	12.5	475	150	235.0		City.
Sandusky	Ohio	l.	July 30	305	15,838	1875		385,605.50			Dec. 31, 1880	1,290,000	12,621.53	13,020.01	20.4	969	146	220.0		City.
South Bend	Ind.	cxxiv.	Oct. 29	433	13,279	1873	1880	225,000.00			Dec. 31, 1880	1,000,000	3,500.00	5,000.00	19.5	600	185	201.0	25	City.
Clinton	Iowa	cxxix	Nov. 5	447	9,068	1874		120,000.00	To 1876.		1878	500,000	5,000.00		8.5	300	85	125.0		Company.

STATISTICS OF 44 TOWNS SUPPLIED BY DIRECT PUMPING.

Name of Town.	State.	Index No.	Date.	Page.	1880.	First Water-Works Built.	Present Works Begun.	Cost.	Remarks.	Bonded Debt.	Year of Returns.	Daily Average Consumption in Gallons.	Yearly Cost of Maintenance.	Yearly Revenue.	Miles of Pipe.	No. of Taps.	No. of Fire Hydrants.	Pressure in lbs., ordinary and fire	No. of Meters.	Ownership.
Indianapolis	Ind.	xxii.	June 4	227	75,074	1870		$1,200,000.00		$500,000.00	1880	3,000,000	$66,018.77	$75,064.49	43	1,900	601	45—100	12	Company.
Columbus	Ohio	lxv	Aug. 12	329	51,665	1870		884,867.27	Includ. maint. & repairs		Mar. 31, 1880	2,150,327	19,544.92	44,572.47	30.5	2,156	319	50—100	534	City.
Minneapolis	Minn	cxxi	Oct. 29	433	46,887	1867		404,287.59	Construction only.		Mar. 31, 1880	3,010,591	14,849.87	20,818.51	18	1,119	256		20	City.
Dayton	Ohio	xlviii	July 30	304	38,677	1869		705,917.80		555,000.00	Dec. 31, 1880	1,058,737	20,483.73	19,644.72	32.5	1,211	286		18	City.
Denver	Col.	cxxxix	Nov. 19	469	35,630	1871		600,000.00		350,000.00	1877	2,125,000	16,719.99	50,046.32	30	2,500	250	50—100	10	Company.
Atlanta	Ga.	lxxvii	Aug. 27	342	34,398	1875		344,000.00			1877	1,132,400	14,001.00	10,217.55	12.4	614	193	50—100		City.
Memphis	Tenn.	clix	Dec. 17	509	33,593	1872		472,278.30	First works.	100,000.00	1880	5,000,000	25,000.00	45,000.00	20.0	3,000	200			Company.
Peoria	Ill.	cxlviii	Dec. 3	488	29,315	1868		450,000.00		450,000.00	1880	2,000,000	18,988.00	24,805.14	43	1,645	267	60—140	6	City.
Norfolk	Va.	lxx	Aug. 20	333	27,730	1872		531,618.75	Sept. 30, 1880.	500,000.00	June 30, 1881	707,934	12,740.56	20,122.77	23	2,200	117		10	City.
Fort Wayne	Ind.	cv	Oct. 8	406	26,880	1880		218,028.63		270,000.00	May, 1881	535,000	2,737.22	2,040.53	26	200	206			City.
Terre Haute	Ind.	lii.	Aug. 6	312	26,040	1871		301,160.35			1880	820,000			19.5		376			Company.
Des Moines	Iowa	cxix	Oct. 22	425	22,408	1871		388,618.39	Includes int. and maint.		Dec., 1880	1,300,000		26,263.83	20		100			Company.
Ottawa	Ca.	xxxiv	July 16	285	22,000	1872		914,000.00			1881	3,292,000	13,001.58	92,502.66	42.94	5,656	332	85—100		City.
Auburn	N. Y.	cviii	Oct. 15	113	21,934	1864		300,000.00			1881	2,000,000			26	200	253			Company.
Taunton	Mass.	liii.	Aug. 6	312	21,213	1876		270,878.18			Dec., 1879	394,031			27.5	681	230		182	City.
Bay City	Mich.	xxxvii	July 16	287	20,653	1872		385,658.58		377,000.00	Dec. 31, 1880		70,365.95	74,078.18	19.5	845	138			City.
Burlington	Iowa	lxxviii	Aug. 27	342	19,450	1877		254,390.71	Includes maintenance.		Dec. 31, 1879	302,170		9,075.80	17.11	561	199		27	Company.
East Saginaw	Mich.	cxli	Nov. 19	469	19,016	1873		360,314.62			1880	1,584,457	8,571.01	9,500.65	21.85	875	149		5	City.
Yonkers	N. Y.	lxxxi	Aug. 27	342	18,892	1873		669,250.66	Construction.		Dec. 31, 1880	900,000	9,462.78	15,905.21	23	750	216		402	City.
Binghamton	N. Y.	lxxiii	Aug. 20	333	17,315	1873		200,000.00		191,000.00	Dec. 31, 1880	1,700,000	18,200.98	28,984.36	23.8	2,300	171	40—60	5	City.
Bangor	Me.	xcii	Oct. 1	386	16,857	1868		500,000.00		425,000.00	Mar., 1881	1,015,484	7,753.75	25,855.87	23.7	1,358	155			City.
Jackson	Mich.	cl	Dec. 3	489	16,105	1875		190,000.00		140,000.00	1880	800,000	7,008.90	8,250.92	18	182	76		4	City.
Lockport	N. Y.	clxiii	Dec. 17	510	13,522	1870					1880	800,000			7	250	133			Holly Co.
Rockford	Ill.	clxx	Jan. 7	6	13,139	1868		290,070.48			1880	900,000	5,791.76	7,278.38	27	1,000	190	57½—110		City.
Keokuk	Iowa	clxxiv	Jan. 14	14	12,117	1878		102,000.00			1880	550,000			11.12	450	76			Company.
Kalamazoo	Mich.	lvi	Aug. 6	312	11,937	1875		168,673.58			Dec. 31, 1880	808,408	6,857.71	5,194.32	15.9	573	147			City.
Jacksonville	Fla.	cxi	Oct. 15	413	10,920	1880		98,000.00			1880				8	200	100		156	City.
Saratoga Springs	N. Y.	xc	Sept. 24	382	10,882	1873		250,000.00	Original cost.	232,000.00	Mar., 1880	780,000 W 1,600,000 S	7,458.57	25,378.32	17.2	1,346	183			Village.
Ogdensburgh	N. Y.	xcvi	Oct. 1	393	10,340	1870		150,000.00	1876.		1876	800,000	2,500.00		14	800	78			City.
Port Huron	Mich.	clvii	Dec. 17	509	10,000	1868		180,000.00		150,000.00	1880	500,254	5,162.32	9,080.12	19	1,037	104			City.
Decatur	Ill.	clxii	Dec. 17	510	9,490	1873		145,000.00			Feb., 1880	250,000	6,553.20	7,183.91	9.58	385	91			City.
Stillwater	Mich.	cix	Oct. 15	413	9,054	1871		200,000.00	Cap. stock, $100,000		1880	1,500,000	2,430.00	3,642.00	7.5	129	87			Company.
Ironton	Ohio	clxiv	Dec. 17	510	9,000	1880		160,000.00			1880	1,500,000	7,500.00	10,000.00	8		114			City.
Danville	Pa.	cxxxv	Nov. 12	459	7,790	1870		164,690.92			1880	360,000	4,500.00		10.1	815	94			Town.
Rahway	N. J.	cxiv	Oct. 15	414	6,439	1872		185,000.00	To 1876.		1876				9		195			City.
Mankato	Minn	lxvi	Aug. 13	329	6,000	1871		16,046.47			1879				3		30	40		
Marshalltown	Iowa	lxxi	Aug. 20	333	6,000	1877		170,820.17			Dec. 31, 1880		34,020.05	18,058.88	7.9	300	69			Town.
Norwalk	Ohio	xci	Sept. 24	382	5,831	1870		174,710.40	Cap. stock, $30,000.		1880	523,606	4,384.45	4,133.73	14	254	84			City.
Niagara Falls	N. Y.	cxxi	Nov. 5	117	5,048	1877		29,165.18	Cap. stock, $30,000.		1878	500,000	2,332.43	3,032.37	5	340	34			Company.
Columbus	Ind.	cvii	Oct. 8	407	4,827	1870		52,000.00	1878.		1878	Not known.			4	180	52			City.
Evanston	Ill.	clxvii	Dec. 24	520	4,820	1874		40,000.00	1878.		1879	300,000	4,500.00		12	400	80			City.
Beaver Falls	Pa.	xcix	Oct. 1	393	4,327	1875		30,000.00	1878.		1879	30,000	1,000.00		6		32			Company.
Paris	Ill.	lxxiv	Aug. 20	333	3,500	1879					1880				6.5		56			City.
Potsdam	N. Y.	c.	Oct. 1	394	3,500	1871		50,000.00			1877		550.00		4.5	140	35			Village.

STATISTICS OF 73 TOWNS SUPPLIED BY PUMPING INTO RESERVOIRS.

Name of Town.	State.	Index to Engineering News.			Population.	First Water-works built.	Present Works begun.	Cost.	Remarks.	Bonded Debt.	Year of Returns.	Daily Average Consumption in Gallons.	Yearly cost of Maintenance.	Yearly Revenue.	Miles of Pipe.	No. of Taps.	No. of Fire Hydrants.	Head in Feet.	No. of Meters.	Ownership.
		Index No.	Date.	Page.	1880.															
Philadelphia	Pa.	ii	March 12	109	846,981	1800		$19,184,957.27			Dec. 31, 1880	60,000,000	$270,580.88	$1,441,555.46	746	110,000	5,883			City.
Brooklyn	N. Y.	iii	March 19	114	566,689	1856				$11,379,500.00	Dec. 31, 1880	30,750,000	272,321.07	1,157,674.22	350	60,000	2,874		1,085	City.
St. Louis	Mo.	vi	April 9	142	350,522	1830	1871	9,126,000.00			April, 1881	25,124,000	224,084.72	660,000.00	212.01	20,264	1,856		980	City.
Cincinnati	Ohio.	viii	April 16	153	255,708	1820		6,778,847.55	Const. only.	1,625,000.00	Dec. 31, 1880	19,476,739	180,527.90	499,857.36	188.89	23,627	900		863	City.
Cleveland	Ohio.	xi	April 23	163	160,142	1853	1874	2,820,514.12	Including interest.	1,200,000.00	Dec. 31, 1880	10,170,461	55,914.86	202,317.12	125.6	10,018	898	140.0	402	City.
Pittsburgh	Pa.	xxv	June 11	234	156,381	1824		1,627,869.12	Old works.		Jan. 31, 1880	16,000,000	120,863.11	400,000.00	112.5		770			City.
Buffalo	N. Y.	xii	April 30	173	155,137	1852		3,050,000.00		2,950,000.00		16,530,000	60,000.00	210,350.00	102.1	9,069				City.
Montreal	Can.	xviii	May 21	203	145,000	1801	1873				Dec. 31, 1880	11,640,000	60,381.14	398,474.81	182.8	31,309	886		305	City.
Newark	N. J.	xiv	May 7	183	136,400	1800		2,671,580.40		3,240,000.00	Dec. 31, 1880	9,380,000	68,082.92	312,719.55	136.2	10,175	1,180		150	City.
Louisville	Ky.	xv	May 7	183	123,645	1856		3,225,368.02		870,000.00	Dec. 31, 1879	5,500,000	40,056.61	176,007.45	110	7,225	339 c. 19 h.		251	City.
Jersey City	N. J.	xx	June 4	226	120,728	1852		4,950,000.00		4,898,000.00	Dec. 31, 1880	11,956,710	129,000.00	450,000.00	325		1,487	161.5	220	City.
Detroit	Mich.	xvi	May 11	198	116,342	1824		2,750,700.89		1,503,000.00	Dec. 31, 1880	15,172,096	45,732.35	380,083.03	200	22,465	174 c. 747 h.		20	City.
Milwaukee	Wis.	xix	May 21	208	115,578	1872		1,851,501.03		1,600,000.00	Dec. 31, 1879	10,603,807	54,805.11	120,505.41	96.3	6,835	673	150		City.
Providence	R. I.	xvii	May 14	195	101,255	1870		4,701,080.93			Nov 5, 1880.	3,110,000	57,868.65	48,680.94	152	9,091	1,137		4,036	City.
Toronto	Can.	xxxi	July 9	271	80,000	1841		2,000,000.00				4,080,000	50,557.00	107,000.00	111.29	8,563	1,070	216	95	City.
Allegheny	Pa.	xxvi	June 18	243	78,681	1847		1,100,000.00			1879	8,000,000	35,000.00	135,000.00	55		825			City.
Richmond	Va.	xxx	July 2	264	63,803	1830		2,500,000.00	Including maint.		1880.	5,814,279	80,000.00	76,485.55	60	6,200				City.
Lowell	Mass.	xxiv	June 11	234	59,485	1870					Dec. 31, 1880	2,254,197			62.97	12,196	672		708	City.
Troy	N. Y.	xxxii	July 16	283	56,737	1829		926,082.16	Entire cost.	300,000.00	Dec. 31, 1880		30,281.00	74,477.35	42.9		400			City.
Kansas City	Mo.	xxvii	July 25	293	55,813	1873									37		280			Company.
Cambridge	Mass.	xxviii	July 25	294	52,740	1855		1,894,755.31		1,528,500.00	Dec. 1, 1880.	2,423,220				7,322	579		156	City.
Syracuse	N. Y.	lxxxii	Sept. 10	351	51,791	1820		650,000.00			1880	4,500,000	18,000.00	56,000.00	45		320			Company.
Paterson	N. J.	cxxxiv	Nov. 12	459	50,887	1850						6,000,000			35	2,400	500			Company.
Nashville	Tenn.	cliv	Dec. 10	503	43,461	1822		1,500,000.00		75,000.00	1880	6,000,000	65,697.93	64,541.42	42					City.
Wilmington	Del.	lxxxviii	Sept. 17	372	42,499	1803		450,000.00			Dec., 1880	3,564,558	18,000.00	68,404.23	51.65	4,814	470			City.
Lawrence	Mass.	xxxv	July 16	287	39,178	1873		1,791,845.14	Includ. int. and main.		1879	1,456,200	28,411.90	62,184.66	40.7	7,001	461			City.
Lynn	Mass.	xxxix	July 23	263	38,284	1871		1,084,234.85		921,500.00	Dec. 31, 1880	1,298,299			57.28	4,488	411		121	City.
Hamilton	Can.	lxxxvii	Sept. 17	372	35,000	1859		915,153.38		991,878.36	Dec. 31, 1880	1,800,000	27,628.56	39,729.07	65.00	8,200	438		2	City.
Manchester	N. H.	xxxvi	July 16	287	32,630	1872		869,572.64			Dec. 31, 1880	1,180,936	113,870.54	157,655.35	38.24	1,807	307		280	City.
Grand Rapids	Mich.	xl	July 23	261	32,015	1810		104,290.01			Dec. 31, 1880	1,107,427	9,417.11	15,157.48	22.28	819	235			City.
Omaha	Neb.	clxxv	Jan. 14	14	30,518	1881		100,000.00			1881	350,000			32	700	255			Company.
Elizabeth	N. J.	cxxii	Oct. 29	439	28,229	1852		500,000.00					30,000.00		40.00		200			Company.
Erie	Pa.	lxxi	Aug. 20	333	27,737	1867		607,311.00		675,000.00	Dec. 31, 1880	2,125,494	13,394.45	38,413.17	35.00	182	92			City.
Salem	Mass.	xliv	July 30	303	27,598	1867		1,338,755.48			1879	1,040,000		50,629.74	85		343		117	City.
New Bedford	Mass.	lix	Aug. 13	327	26,875	1865		1,294,561.87	Entire cost.	700,000.00	Dec. 1, 1880	2,014,200	14,488.67	39,644.48	42.27	3,798	295		22	City.
Oswego	N. Y.	cxlv	Nov. 20	480	21,117	1868											175			Company.
London	Can.	lxi	Aug. 13	328	21,000	1878		300,000.00	Including interest.		Dec 31, 1880	1,250,000			36		200			City.
Newport	Ky.	xlv	July 30	304	20,433	1871		780,781.11	Including repairs,	700,000.00	Dec. 31, 1880		13,288.30	21,861.39	20.45	1,577	110		16	City.
Poughkeepsie	N. Y.	lviii	Aug. 6	313	20,207	1870		602,545.50	1871.		Dec. 31, 1880	1,408,202	18,026.85	19,379.40	16.2	1,326	298		122	City.
Pawtucket	R. I.	lxxv	Aug. 20	333	19,030	1877		641,709.10			Feb. 1, 1880	8,000,000	6,122.38	34,080.54	65.1	2,043	471		1,065	City.
Zanesville	Ohio.	cxliv	Nov. 26	480	18,120	1842		500,000.00		300,000.00	Dec. 31, 1880	1,947,000	17,200.65	28,897.31	33.81	2,388	154	185	6	City.
Allentown	Pa.	ciii	Dec. 3	489	18,063	1827		180,054.78		185,622.00	Dec. 31, 1880	1,000,000	3,403.68	16,438.75	18	2,400	95		18	City.
Newton	Mass.	liv	Aug. 6	312	16,995	1875		854,307.73			Dec. 31, 1880	408,476	9,758.70	33,734.58	60.3	1,937	324		467	City.
Montgomery	Ala.	lxiii	Aug. 13	329	16,714	1878						1,000,000			10	550	103			Company.
Akron	Ohio.	clv	Dec. 10	503	16,512	1880		250,000.00	Capital stock.	200,000.00		Begun 1881.			20	600	157		10	Company.
New Albany	Ind.	lxii	Aug. 13	328	16,422	1875		200,000.00		100,000.00	Dec. 31, 1880	800,000		25,000.00	10	750	147			Company.
Lynchburgh	Va.	lxxxix	Sept. 17	373	15,959	1796	1828	222,491.61			Dec. 31, 1880	1,250,000	6,841.37	12,337.05	18	750	181			City.
Newport	R. I.	clxxii	Jan. 7	6	15,693	1875		500,000.00	Capital stock.		1880	500,000			30	1,160	157		27	Company.
Chester	Pa.	xxiii	Oct. 1	393	14,996	1867		70,000.00	Original cost.		1875 & 1878.		5,000.00	26,000.00	12	1,100	75			South Ward
Norristown	Pa.	clxxiii	Jan. 7	6	13,863	1847		275,000.00		90,000.00	1880	800,000			27	2,500	85			Company.
Nashua	N. H.	cxiii	Oct. 29	439	13,397	1855		225,000.00	Const. and maint.		1880	1,000,000	10,000.00	30,000.00	23	1,600	75	132		Company.
Rome	N. Y.	xciv	Oct. 1	393	12,015	1872		165,000.00			1878		3,000.00	9,000.00	15	400	100			City.
Alexandria	Va.	lv	Aug. 6	312	11,987	1851					1879		4,241.07	14,630.62						Company.
Waltham	Mass.	clxi	Dec. 17	509	11,711	1873		305,792.13			Dec. 31, 1880	411,000	4,984.39	25,132.86	23.83		130			City.
Jacksonville	Ill.	cxi	Oct. 15	413	10,929	1873		150,000.00	1876.		1876	225,000	3,500.00		9	200	70			City.
Alton	Ill.	civ	Oct. 8	406	9,500	1875		105,000.00			Dec. 31, 1880	200,000	3,600.00		13	100	95		50	Company.
Meadville	Pa.	cxxxiii	Nov. 12	448	9,000	1874		115,000.00	Capital stock, 125,000		Nov., 1881	280,000	3,153.79	25,448.44	15.5	800	100			Company.
Bridgeton	N. J.	clxx	Dec 31		8,722	1877		79,070.00		78,000.00	Dec. 31, 1880	108,308	1,494.81	6,369.30	10.6	392	72			City.
Hudson	N. Y.	xlii	July 23	264	8,670	1874		256,000.00			1879	938,187	7,645.12		12.5		176			City.
Muscatine	Iowa.	cxiii	Oct. 15	414	8,294	1875		39,500.00	1876.		1878				8.5		40			Company.
Bellaire	Ohio.	cii	Oct. 1	391	8,000	1872		112,000.00	1877.		1878		5,000.00		6.75			165		Town.
Sherbrooke	Can.	cxlvi	Nov. 20	481	7,000	1880-1		150,000.00			1880				4		75			Company.
Peekskill	N. Y.	lxxvi	Aug. 27	341	6,893	1875		196,300.00			Dec. 31, 1880	180,000	1,826.16	3,361.49	10.33	371	84			City.
Phoenixville	Pa.	lxxxv	Sept. 10	365	6,692	1872		200,000.00			Dec. 31, 1880	354,000	7,588.41	10,088.06	10.6	1,200	100			Town.
Conshohocken	Pa.	cvi	Oct. 8	406	4,800	1873		70,000.00			1876				4.26	200	40			Company.
Rome	Ga.	xcv	Oct. 1	393	4,374	1871		165,000.00			1878		3,000.00	9,000.00	15	400	100			City.
Birmingham	Ala.	xcviii	Oct. 1	393	4,050	1872		66,500.00	1876.		1876	1880, 100,000	1,200.00		6.50	200	15			Company.
Lyons	Iowa.	cxxx	Nov. 5	447	4,000	1876		40,000.00			1880	50,500	1,400.00	3,600.00	2	150	30			Company.
Anamosa	Iowa.	cxlii	Nov. 19	469	2,500	1875		20,000.00			1880	24,600	1878, 700.00	1,643.00	1.3		7			Company.
Mt. Joy	Pa.	cxvi	Oct. 15	414	2,083	1873		35,000.00	1877.		1877				3.7		23			Town.
Tioga	Pa.	cxv	Oct. 15	414	1,200	1874		16,000.00	1877.		1877	10,000	250.00		3	120	14			Company.
Lincoln	Mass.	clviii	Dec. 17	509	907	1875		33,000.00		30,000.00	1880		500.00		3.5	23	11			Town.
Pleasant Hill	Ky.	cii	Oct. 1	391	300	1872						1,000								Company.

STATISTICS OF 47 TOWNS SUPPLIED BY GRAVITY.

Name of Town.	State.	Index to Engineering News.			Population.	First Water-works built.	Present Works begun.	Cost.	Remarks.	Bonded Debt.	Year of Returns.	Daily Average Consumption in Gallons.	Yearly cost of Maintenance	Yearly Revenue.	Miles of Pipe.	No. of Taps.	No. of Fire Hydrants.	No. of Meters.	Ownership.
		Index No.	Date.	Page.	1880.														
New York	N. Y.	i	March 5.	91	1,206,590	1799	1842.	$69,328,697.18	Inc. int. and maint.	$15,506,000.00	1881.	95,000,000	$347,488.95	$1,633,501.65	510	80,000	6,400	5,500	City.
Boston	Mass.	v	April 2.	131	412,000	1846		18,374,766.94	Exc. of int. and main.	12,784,278.98	May 1, 1881.	85,900,000	312,998.48	1,365,200.69	500	69,504	4,689	1,631	City.
Baltimore	Md	vii	April 16	151	332,190	1808		10,029,734.17		9,000,000.00	1880.		87,419.31	606,879.06	277.86	49,000		524	City.
San Francisco	Cal.	ix	April 23	168	233,956	1857		8,746,928.12	1875.		1875.	'80-17,000,000	800,000.00		220.00				Company.
Washington	D. C.	xiii	April 30	174	147,307	1864		5,500,000.00	Cost and maint.		1880.	26,000,000	82,696.06	69,459.60	175	17,000			U. S. Govt.
Albany	N. Y.	xxi	June 4	226	90,903	1813	1830-1873				1879.	5,000,000	57,853.28	36,235.37	77.83	2,832	493	10	City.
Rochester	N. Y.	xxiii	June 11	283	89,363	1873		3,500,000.00		3,000,000.00	April, 1881	5,000,000	39,155.97	74,660.39	112.8	7,588	979	100	City.
New Haven	Conn.	lxxxvi	Sept. 17	372	62,882	1860		842,521.55		225,000.00					102	4,904	362	54	Company.
Worcester	Mass.	xxxii	July 9	272	58,295	1798	1865.	801,262.23	Construction only.		1877.	3,500,000	15,124.87	84,325.80	79.94	5,200	683	3,791	City.
Quebec	Can.	cliii	Dec. 10	503	50,000	1853		1,300,000.00		1,300,000.00	1880.	3,000,000	10,000.00	90,000.00	27.5	5,016	222		City.
Hartford	Conn	xxxviii	July 23	298	42,553	1854	1865.	1,497,408.25		1,052,000.00	1880.	4,500,000			70.6	4,904	362	54	City.
Halifax	N. S.	lxxxiii	Sept. 10	364	36,102	1845		741,000.00				5,000,000	10,000.00	62,000.00	55.00	4,291	315		City.
Utica	N. Y.	cxx	Oct. 22	425	33,913	1849									30		190		Company.
Portland	Me.	cxviii	Oct. 22	425	33,810	1869		1,800,000.00		1,200,000.00			10,000.00	100,000.00	37.2	4,616	243	48	Company.
Springfield	Mass.	xliii	July 30	302	33,340	1860		1,216,847.58			1880.		10,008.31	79,280.92	63.93	3,290	381	44	City.
Wilkesbarre	Pa.	cxlvii	Nov. 26	481	23,339	1859		220,000.00	Wilkesbarre W. Co.	17,000.00	April, 1881			29,415.00	33	600	94		2 Companies.
Dubuque	Iowa	cxl	Nov. 19	469	22,254	1871		140,000.00	Cap. stock, $300,000.		1880.					501	117	12	Company.
Holyoke	Mass.	xli	July 23	294	21,851	1873		312,142.29			1880.		28,862.52	39,382.52	24	3,689	441	59	City.
Norwich	Conn	xlvi	July 30	304	21,111	1868		411,870.94			March, 1880		6,262.62	24,160.24	30	1,503	245		City.
Salt Lake City	Utah	clx	Dec. 17	509	20,678	1874		250,000.00			1880.	250,000	20,902.73	8,509.60	11		128		City.
Waterbury	Conn	lxvii	Aug. 20	332	20,029	1868		327,277.82		225,000.00	1880.		4,950.54	25,497.77	29	1,863	166	50	City
Altoona	Pa.	lxxix	Aug. 27	342	19,740	1871		300,000.00		200,000.00	1880.	500,000		12,000.00	16	1,400	98		City.
Williamsport	Pa.	xlvii	July 30	304	18,934	'53-'65										2,500	150		2 companies.
Meriden	Conn	cxliii	Nov. 26	480	18,340	1869		350,000.00		325,000.00	1880.	1,000,000	5,790.39	32,561.74	24	1,700	190	51	City.
Newburg	N. Y.	lxviii	Aug. 20	332	18,050	1853		432,891.43		284,500.00	Mar. 7, 1881		4,863.69	27,334.50	20.5	1,789	181		City.
Johnstown	N. Y.	lxxx	Aug. 27	342	16,626	1878		59,806.11		60,500.00	Apr. 30, 1879.		728.79	2,800.00	4.6	109	53		City.
Racine	Wis.	cli	Dec. 3	480	16,031	'70-'78	Co. & City.	14,000.00			1880.					200	4		Co. and City.
Leadville	Col.	clvi	Dec. 10	503	14,820	1879		300,000.00	Capital stock	65,000.00	1881.	1,000,000	12,402.15	30,722.85	8	250	52	2	Company.
Pittsfield	Mass.	cxii	Oct. 15	413	13,367	1851		165,000.00			1878.	1,500,000	1,800.00		30	1,800	70		City.
Northampton	Mass	lxiv	Aug. 13	329	12,172	1870		209,822.84			1880.		2,241.38	17,702.12	22		125		City
Danbury	Conn	lxxxiv	Sept. 10	364	11,669	1833	1860.	108,405.62			1880.		1,820.00	11,198.97	15		105		City.
New London	Conn	lvii	Aug. 6	313	10,529	1872		291,840.00			Sept., 1880.		3,000.00	16,647.32	21	1,285		25	City.
Plymouth	Mass.	cxxxvi	Nov. 12	459	7,094	1855		135,000.00		90,000.00	1880.	450,000	2,326.99	11,243.18	19.75	1,083	54		City.
Birmingham	Conn	xcvii	Oct. 1	393	7,000	1860		60,000.00	1876.		1880.		2,500.00		5	300	47		Company.
Keene	N. H.	cxxxii	Nov. 5	447	6,789	1869		162,660.58		150,000.00	Dec. 1, 1880.		1,182.94	8,487.76	20.5	885	121		City.
Mauch Chunk	Pa.	clxviii	Dec. 24	520	5,606	1849		25,000.00			1880.		750.00		4	430	28		Company.
Corning	N. Y.	lxix	Aug. 20	332	4,808	1870		40,000.00			1880.	250,000			7	200	45		Company.
Winsted	Conn	clxv	Dec. 17	510	4,500	1861		100,000.00		25,000.00	1881.		2,666.17	4,704.94	10		85		Town.
Lambertville	N. J.	lx	Aug. 13	328	4,300	1878		20,000.00			Mar. 1, 1880.		2,908.86	4,750.19	3.72	50	28		Company.
Susquehanna	Pa.	cxxvi	Oct. 29	434	4,114	1874		6,000.00			1880.		55.00	600.00	0.75	700	5		Company.
Concord	Mass.	cxxvii	Oct. 29	434	3,235	1874		71,000.00			1880.		700.00		7.00	300	50		Town.
Hollidaysburg	Pa.	clxix	Dec. 24	520	3,139	1877		73,000.00			1880.		228.00		8.00		45		Town.
Bedford	Pa.	cl	Oct. 1	394	2,564	1872		31,000.00			1878.	30,000	275.00		8				Town.
Stockbridge	Mass.	cxxviii	Oct. 29	434	2,361	1860		9,500.00			1880.		246.00	900.00	3.50	95	5		Company.
Great Barrington	Mass.	cxxv	Oct. 29	434	2,311	1868		20,000.00			1880.				3.00	225	21		Company.
Avon	N. Y.	clxvi	Dec. 24	520	1,600	1857		18,000.00			1880.	200,000	200.00		10.00	60	10		Company.
South Hadley Falls	Mass.	cxvii	Oct. 15	414	1,500	1872		5,400.00			1876.		500.00		6.00	230	42		Town.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 24.)

CLXXXI.—ALLEGAN.

Allegan, Michigan, in lat. 43° N., long. 87° W., on the Kalamazoo River, is in a valley surrounded by seven hills. The river has a rapid descent, affording a fine water power. Settled in 1833, it was incorporated as a village in 1837.

Water-works were built by the village in 1871 after the plans of Mr. Phelps, of Kalamazoo, taking the supply from two large wells sunk near the river which is dammed at this point by a dam of stone and earth 8 ft. high, which furnishes head to drive a turbine wheel which operates two Holly rotary pumps forcing water directly into the mains with an ordinary pressure of 80 lbs. and fire pressure of 120 lbs.

Distribution is by cast-iron pipe, of which 4 miles are laid of from 12-in. to 4-in. diameter, with 38 fire hydrants and 200 taps. Wrought-iron service pipe is used.

The population in 1880 was 3,010, and the daily consumption 25,000 gallons.

The works have cost $80,000 and the gross receipts have been about $110,000. There is a bonded debt of $17,500 bearing 10 per cent. The receipts in 1880 were $1,198 and the expenses $1,265.

The works are managed by a superintendent. This was held for three years by Alvy Rossman, and for seven years past by Clark Nichols.

CLXXXII.—SARNIA.

Sarnia, Canada, is on the St. Clair River, 2 miles below the foot of Lake Huron. Settled in 1830 it was incorporated as a town in 1857. Water-works were built by the town in 1876, under the direction of a committee of the council and R. Turner.

The supply is taken from the river through a 20-in. iron pipe 206 ft. long, and pumped directly into the mains by four Holly steam pumps arranged in pairs and working horizontally, each pair connected to one shaft. One pair has steam cylinders of 15-in. and water cylinders of $8\frac{1}{2}$-in. bore, with 18-in. stroke. The other pair has steam cylinders of $10\frac{1}{4}$-in. and water cylinders of 6-in. bore, with 15-in. stroke. The ordinary pressure is 33 to 35 lbs. and the fire pressure 80 to 110 lbs. Wood is used for fuel. Distribution is by cast-iron pipe of from 12 to 4-in. diameter, of which 9.20 miles are in use, with 74 fire hydrants, 131 gates and 528 taps. Lead service pipe is used.

The population in 1881 was 4,000 and the daily consumption 280,000.

The works have cost to Dec. 31, 1881, $59,590.60, and the receipts have been $17,699.75. The bonded debt is $70,000, bearing 6 per cent. interest. The interest is paid out of taxation. In 1881 the expenses were $2,635.74 and the receipts $4,184.44. The only accident which has occurred was the breaking of the suction pipe by ice a few years ago. This was repaired at a cost of $900. Robert Turner, the engineer and superintendent of the works, reports to a committee of the council.

[TO BE CONTINUED.]

The receipt of statistics as follows is acknowledged with thanks. From Stiles Kennedy, President, statistics and water rates of St. Louis (Michigan) Water-works. From Clark Nichols, Superintendent, statistics and water rates Allegan, (Michigan) Water-works. From A. A. Rankin, Water Commissioner and Superintendent, statistics and water rates of Greenfield (Mass.) Water-works. From C. R. Stickney, Clerk of Water Co., statistics of Chicopee (Mass.) Water-works and water rates. From Thomas C. Lovell, Superintendent, statistics of Fitchburg (Mass.) water-works and full set of reports of water commissioners from 1871 to 1880. From J. T. Sawyer, President, statistics and rates of water-works of Waverley (New York) Water Company. From D. A. McDonald, Manager, statistics and water rates of Batavia (N. Y.) water supply. From Robert Turner, Chief Engineer, statistics and water rates of Sarnia (Canada) water-works and reports for 1880 and 1881. From Charles W. S. Seymour, Superintendent, statistics and water rates of Hingham (Mass.) Water Company. From J. B. Quigley, Superintendent, statistics of Atchison (Kansas) Water-works. From James Middlemist, Superintendent, statistics of Delhi (N. Y.) Water-works Company. From J. O. McClure, Engineer, statistics and water rates of Warsaw (N. Y.) Water-works Company. From J. R. Todd, Registrar, municipal reports of Norfolk, Va., for year ending June 30, 1881.

In the tables which we publish to-day giving statistical information regarding the water-works of 175 towns, our readers will notice several blank spaces. The reason of this is that the information needed has not been furnished in reply to requests sent for it. We trust that some person in every one of the towns the statistics of which are imperfect, will, as soon as practicable, forward to Mr. Croes the missing data.

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.
Tribune Building, New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR .... ASSOCIATE EDITOR.

SATURDAY, JAN. 28, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

NOTICES OF MEETINGS

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The regular meeting of the Society will be held on next Wednesday evening, at 8 o'clock, in the house of the Society, 127 East Twenty-third street.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The annual meeting will be held in Washington, Feb. 21, 1882

PROF. A. J. DU BOIS, Mem. A. S. C. E., Yale Scientific School, will lecture at Association Hall, Twenty-third street and Fourth avenue, this city, in the Lecture Course of the Young Men's Christian Association, on Friday evening, Feb. 3. Subject: "The Early History of the Steam Engine."

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EUROPEAN SYSTEMS OF SEWERAGE.

In 1880 Mr. Rudolph Hering, Civil Engineer, of Philadelphia, visited Europe for the purpose of examining the various systems of sewering cities as practiced there and the applicability of the various methods in use, wholly or in part, to this country, and in a report made to the National Board of Health gives at length the result of his observations with a thoroughness which leaves nothing to be desired. The National Board of Health published this report in a supplement to their Bulletin of Dec. 24, 1880. Mr. Hering spent many months in the examination, and the report is the result of much patient labor and close observation, and shows an intelligent grasp of the salient points of this intricate problem as exemplified in the practice of the oldest countries, and illustrates the principles deduced therefrom so happily that, in the interest of sanitation in this country, we are induced to call attention to this report as embodying *principles* which are applicable to all localities. In the cities of London, Paris, Berlin, Vienna, Liverpool, Hamburg, Frankfort-on-the-Main, Dantzic, Brighton, Oxford and Amsterdam Mr. Hering furnishes copious notes under the various headings of statistics of the locality, population, area, number of dwellings, mortality, etc., management of the works, design and construction, shape, size, depth, grade, ventilation, etc., of the sewers, materials of construction, disposal of sewage, cost of construction, as also of management and maintenance and details of all important appliances in vogue in these various cities, from the operations of which, as observed by him, he deduces the principles enunciated in his report. The drawings accompanying this report, we learn, are marvels of accuracy and clearness, and which will be published by the National Board of Health, in their Bulletin for 1881.

The reports of the various cities are very minute, and do not admit of epitomizing, but will form the subject of future papers in ENGINEERING NEWS, as being of great value to our readers.

In the introduction, the author considers the various causes which tend to influence the judgment in forming an opinion as to the merits of particular systems to be accepted, and shows that the question should really resolve itself into considering it in *two* aspects: First, as the works are to receive, convey and discharge organic waste products, the decomposition of which is either directly or indirectly the cause of unhealthy influence, it is necessary to examine them, first of all, from a *sanitary* point of view. When a satisfactory standard in this direction can be reached, the next inquiry is into the expense attached to their execution; in other words, into the least possible *cost* at which a sanitary condition can be attained. These two considerations alone decide their merits. It will be found that several of the systems, if properly designed, constructed and maintained, will have no serious sanitary defects, and that their relative advantages will depend mainly on the question of *cost*. As the latter varies with the local conditions, it is evident that these will almost wholly determine the selection of the system.

GENERAL SYSTEMS AND THEIR APPLICATIONS.

These systems are two, the "dry removal" and the "water carriage." After explaining the principles of each, and considering the circumstances under which "cesspools" are least harmful, and are to a certain extent admissible in certain localities, the author proceeds to explain the various methods in use, for "dry removal," and concludes that it can compare favorably with the "water-carriage" system only under the following circumstances:

1. Small towns, on account of the expense of cartage.
2. Towns where the regular exchange of the pails used can be enforced with almost military exactness, as in barracks.
3. Dwellings where water closets cannot be used.
4. Localities where works of sewerage would be very expensive; and
5. Where the waste water can be led over the surface of the ground without causing offense.

It will depend, therefore, entirely on local requirements and peculiarities, to determine which of the two methods is more desirable.

The system by "water carriage" (what is called "sewerage") is then examined, which consists in a system of continuous underground impermeable channels causing an immediate and complete self-removal of all excreta and waste water from the dwelling to the place of final deposit or disposal.

The history of the subject then comes up, and the circumstances under which the demand for improvement in sewerage works arose, and the origin of the "separate" system of water carriage, and the reason for regarding some one of the water-carriage systems as preferable to the dry methods, and the circumstances under which it is to be preferred, as

1. When a regular water-supply in sufficient quantities is furnished to the dwellings, this being the most essential condition.
2. When waste water is sufficiently abundant and foul, and therefore requires rapid removal to a distant point, which will usually follow the present condition, especially in large towns.
3. When the population is dense, which relatively decreases the expense per inhabitant.
4. When the topographical features and locations of the town do not require an unreasonable outlay of money. Water carriage, for instance, would not be economical to small towns on very steep and irregular slopes, with the rock near the surface, or where the site is a long, narrow strip along the shore of a large river, when the expense of sewerage would be out of proportion to its benefits over the dry-removal method.
5. Where the disposal of sewage offers no great difficulties or expense.
6. Finally, in general, where the interest of the amount invested in sewerage bonds will be smaller than the cost of dry removal, provided the latter is kept up to a sanitary standard. This condition will cause the advantages of water carriage to increase with the size or the cities, but the precise point at which sewerage becomes cheaper than the dry removal can only be determined from the local peculiarities.

After considering the relative merits of the dry method, and that of the general water carriage, we come to consider the latter more in detail, when it divides itself into the "combined" and "separate" system; the latter again sub-divided into the ordinary, the Shone, and the pneumatic, or Lierneur-systems.

The *combined* system consists in a network of sewers, having sufficient capacity for the removal of a certain amount of storm water, in addition to the sewage, and having inlets for its reception along the streets as well as in the yards and houses.

The necessary arrangements with reference to street-basins, traps, ventilation and inspection are than stated, and the combined system, which is the one generally in use with us, is carefully considered in all its bearings, and, after giving the advantages of the method, the objections which are urged against it by the advocates of the separate system are fairly given, so that one should be in no doubt as to their relative merits. The objections against the combined system, on sanitary grounds, are considered as substantiated only when it has been imperfectly designed, built, maintained or applied—difficulties to which the separate system is equally exposed, and perhaps from its greater complexity in some cases even in a greater degree. Where purification of sewage is needed it will depend upon local conditions whether the combined system, with proper interception of sewage, is to be therefore avoided, but our author is positive that it "will not be on any general defect of the system itself."

The expense of a sewerage system does not merely include its first cost, but its annual cost as well, for maintenance. When systems are compared financially, it should be done with reference to the objects they accomplish. The combined can naturally only compete with the separate system "in cases where both sewage and rain-water alike are to be provided for." The economy of the combined or separate system depends mainly on the following conditions:

Where rain-water must be carried off underground from extensive districts, and where new sewers must be built for this purpose, it will generally be cheaper; also in densely inhabited districts, from the circumstance that the proportion of sewage to rain-water will be greater, and therefore increase the sizes of the separate-sewage pipes, yet without decreasing those of the rain-water sewers; while the sizes of the combined would not vary with the population because the quantity of sewage is much less than the quantity within which the amount of storm water can be estimated; but what is of more importance is the fact, that in closely built up sections the surface washings from slight rains would carry an amount of decomposable matters into the rain-water sewers, which, when it lodges as the flow ceases, will cause a much greater storage of filth than in well-designed combined sewers which have a continuous flow, and generally also appliances for flushing. In cities which give indications of rapid growth these points becoma of importance when selecting a system.

Separate System.—The ordinary separate system as used in England consists of a pipe line extending into each house, there to receive the house drainage, generally with soma rain-water from the yards and back buildings. Tha remainder of the rain-water is taken off through separate sewers, or over the surface. Flushing arrangements of some kind are necessary, as are also man-holes for inspection. Where the Field tank is used, no necessity exists for taking any rain water into the house drains. But experience is still needed to determine how for it becomes proper to exclude all rain-water. Good examples of this system are found at Oxford, Reading, Tottenham and soma other small English towns.

The Shone System.—This is a variation of the ordinary separate system, and consists in lifting small quantities of sewage at any convenient number of points, so that it can continue its course in shallower sewers, and with better grade. The economy and convanience of compressed air in transmitting power to long distances in comparison with steam direct makes the principle a practical one, but this method has been put in operation as yet but on a small scale for experiment in one locality in Wrexham, but the principle would appear to be sufficiently applicable to peculiar localities as to justify its consideration as a system, the valua of which remains to be proved.

The Lierneur or pneumatic system is then explained, and the relative merits of these separate systems, as compared with the combined, are fully gone into; and as the sanitary demands upon a system of sewerage consist in the prevention of decomposition to the greatest possible extent, this object can best be obtained by a rapid, steady and complete removal of all decomposable matter entering the sewers in a fluid state, and also such solids as occasionally enter them and obstruct the flow, and a provision for the safe escape of vitiated air. These demands can be fulfilled within satisfactory limits by each of the system named, provided they are designed and built in a perfect manner, and in accordance with the peculiarities of the locality and proper care given to the maintenance. A misapplication on one hand, a neglect on tha other, may have a greater influence on the sanitary condition growing out of any single system than the difference between any two systems can hava under good conditions; and as the conditions are so liable to variation in different localities no one particular system can possibly be the best for all localities.

Mr. Hering, after a careful review of all that has been accomplished and a proper consideration of what has been promised, reaches the following conclusions as to the requirements of the several systems.

"The combined system is suitable when rain-water must be carried off underground from extensive districts, especially when they are closely built up, as in large cities, and where new sewers must be built for this purpose.

"Where purification is not required or is not difficult, and storm-water overflows are not objectionable in polluting the streams.

"Where a sufficient amount of water or sewage is available for flushing the larger sewers.

"The best examples were found in Frankfort, London, Hamburg, Brighton, Liverpool, Berlin and other towns.

"The separate system is suitable where rain-water does not require extensive underground removal and can be concentrated in a few channels slightly below the surface, or where it can safely be made to flow off entirely on the surface.

"Such conditions are found in rural districts, where the population is scattered, on small or at least short drainage areas and on steep slopes or side-hills.

"Where there is an existing system of old sewers, which cannot be made available for the proper conveyance of sewage, yet can be used for storm-water removal.

"Where purification is expensive, and where the river or creek is so small that even diluted sewage from storm-water overflows would become objectionable, especially when the water is to be used for domestic purposes at no great distance below the town.

"Where pumping of the sewage is found too expensive to admit of increased quantity from intercepting sewers during rains, which can occur in very low and flat districts.

"Where it is necessary to build a system of sewers for house drainage with the least cost and delay, and the underground rain-water removal, if at all necessary, can be postponed.

"Under such conditions the ordinary separate system can generally be applicable, yet certain special features of the locality may determine in favor of Shone's system; for instance:

"Where pumping of the sewage to moderate elevations is advantageous or required at several or numerous points not greatly distant from each other, in order to increase the grade and velocity between them.

"Where deep excavation is very expensive, either from being under the level of subsoil water or in rock, and where shallower sewers with better grades and intermediate lifts could be substituted, as in undulating grounds with rock near the surface when the sewage is to be carried across the ridges, or in low-lying and very flat districts with excavations under water.

"Finally, in mentioning the applicability of Lierneur's system, it must be added that it is extremely doubtful whether it can compete with the other systems in any locality.

"In conclusion it may be said that as quite different conditions may occur in the same town, it is possible and practicable to adopt several systems for it. It may be found expedient to exclude rain-water from certain areas, whereas the combined system would be advisable in others."

ON THE DESIGN AND CONSTRUCTION OF SEWERS.

The *alignment* is first considered, and its bearing on the efficiency of the works shown, but the reference to plates (which are as yet unpublished), as essential to a proper understanding of the subject, will prevent our following the author in this branch of the subject.

The next consideration is that of size, shape, grades and construction.

Size.—This, as aside from other considerations affecting very seriously the cost, is a matter of the first importance. If too large, it is liable to become obstructed by deposits, and if too small, to choke, or fail to carry off the sewage.

Experience has led engineers to be careful in both directions. The smallest sizes for common sewers used in Europe are 8 or 9 inches. Up to a diameter of 18 or 20 inches, vitrified pipe are used, beyond this concrete or brick. Where sewage alone is to be conveyed, its quantity determines the size. This quantity is usually taken as equal to the water supply, but unlike the latter, about one half is estimated as discharged in from six to nine hours, and should fill the sewer to about one half of its capacity. Where rain-water is to be carried off the quantity estimated is very variable; this variation and the causes are explained, and attention called to the variation which appears between the amount of rainfall in a given time, and the amount which reaches the sewers, and the necessity which exists for more extended observations on this point. In this connection, as it is well known that over extended areas the amount to be delivered is not in the direct ratio of the areas to be drained, Mr. Hering submits a formula (the result of extended observations in Germany) for the determination of this quantity and wherein the amount given by the formula increases as the rate of rainfall increases, as the slope increases and as the surface is less premeable to the water, and *decreases* proportionately as the area increases. The only formula heretofore in use which has a similar tendency is the one recommended by the editor many years since, and used by some engineers, known as Hawksley's, which was used in the main drainage works of London for the outfall of storm waters. I s this, A = acres drained with a rainfall of 1 in. to the hour.* N = length in feet in which the sewer falls 1 ft.

$$\frac{3 \log. A + \log. N + 6.8}{10} = \text{log. diam. of outfall in inches.}$$

The formula recommended by Mr. Hering is:

$$Q = c\, i \sqrt[4]{\frac{S}{A}}$$

wherein Q = cubic feet per acre per second reaching the sewer.

c=coefficient ranging from 0.31 to 0.75, depending upon the nature of the surface; the higher coefficient being for paved streets and roofs, the lower for rural sections in suburbs.

i=average intensity of rain during the period of the heaviest fall, in cubic feet per second per acre, the amounts ascertained for Central Europe being found to be at the rate of from $1\frac{3}{4}$ to $2\frac{3}{4}$ per hour.

S=general grade of area drained per thousand.

A=area drained in acres.

Eytelwein's formula is generally used in London, Berlin, Hamburgh and Liverpool; Prony's in Paris; Darcy and Barquis' in Vienna, Lindley's in Frankfort. The results differ but little when the formula is properly applied.

Shape.—The shape of sewers is not uniform in practice. Generally the egg shape is adopted for all sewers of the combined system, when large enough to be entered; when smaller, the circular shape is preferred. In Paris, owing to the method of cleansing by flushing trucks, a composite section becomes necessary, the edges of a *cuvette* in which the sewage flows being provided with iron rails for the wheels of the trucks. On one or both sides is a foot-path for the workmen, and the whole covered by a semicircular arch, within which water pipes and telegraph wires are suspended. Branch sewers in Paris are oval.

The egg-shaped sewers in Paris, Vienna and Hamburgh have a comparatively flat invert, others more pointed ones, as in England, in Frankfort and Berlin. The latter appear the more preferable form, as they were found to need less cleaning and flushing than those with flat inverts. In Frankfort, where on account of the narrow streets many of the sewers were built by tunneling, it was preferred to build brick sewers 3 ft. high where, indeed, a pipe sewer would have sufficed.

Gradients.—The grades determined measurally by that of the streets, are made, as a rule, as great as practicable. In England it is not recommended to give a velocity greater than 6 ft. per second, to avoid wearing away the inverts. In Berlin, the velocity is reduced to that which will prevent deposit. House connections require a grade seldom less than 1 in 50. Valley line sewers rarely less than 1 in 1,000, and intercepting sewers were given grades as low as 1 in 4,200, as in Paris. In Hamburgh and Westham, near London, some were built even level, and during floods discharged in either direction. In the discharge of storm water, the hydraulic grade is to be considered, and not that of the invert; this is particularly necessary to be regarded in sewers discharging at tide water, the hydraulic grade having its reference to high tide. It will be noted, that to give the same velocity as large sewers, the grade of small sewers must be greater than the large.

Construction.—One of the reasons why the European sewerage works, whenever they had any pretensions of being built on a system, are better than ours, is mainly owing to the greater care which is generally given to their construction. The materials are more carefully selected, and the works are more substantial. Sub-soil drainage is affected in some places, as Oxford and Berlin, by a line of drain-pipes laid below the sewer. In Vienna and Breslau they are laid over or on each side.

The relative smoothness of the sewers is found to have an appreciable influence in preventing deposits. Pipes, except near dwellings, when grease adheres to the sides, show but a slight coating of adhering matter, as compared with sewers of brick and stone. Concrete, when smoothly plastered with cement, likewise showed but a slight coating, if any. The odors from concrete sewers so plastered were said to be less than from brick sewers, and inspection confirmed it. In Vienna one of the water reservoirs was partly lined with a smooth coating of cement, and partly faced with sandstone. The clean condition of the former, compared with the slimy, greenish surface of the latter, although built at the same time, would seem to confirm this opinion.

Junctions.—Attention is called to the proper method of connecting branches, as of more importance than generally supposed. House drains and small pipes are usually made from 30° to 45°; on large sewers, with as long radius as is practicable, but in smaller sewers other considerations may limit the length of curve to the length of a man-hole, that one man-hole may command a view for inspection over two tangents. In large sewers, to prevent eddies (a fruitful cause of deposits), great care is necessary to make the junction as gradual as possible, and at the same time the channel district. This is effected by the so-called "tongues," built at the intersections, which cannot be well explained without the drawing. Eddies, and therefore deposits, were entirely avoided by this device, as was apparent wherever they were used in England, Frankfort and Hamburgh, and the reverse apparent where they were not used in Berlin and Paris.

Appendages, such as street basins, man-holes, outfalls and overflows are next considered. Great diversity of practice obtains as to the size of the street basins. Their depth is dependent upon the climate, being twice as deep in Germany as in England, and with reference to the vicinity for tapping the outlet to the sewer, in some localities it appears to have proved beneficial to dispense with any taps for the street basin, but Mr. Hering is not prepared to recommend it for American cities. The use of man-holes varies both in dimensions and frequency. Over small sewers, they should be at less intervals than in large sewers, and should be placed at every change of direction and grade. In Paris they are fixed at 164 ft. apart; in Vienna the distance is about 260 ft.; in Hamburg 350 to 400 ft.; in Frankfort 540 to 600 ft. for large and 250 to 300 ft. for small sewers, and have open grating covers for ventilation, and catch-pans beneath to arrest the street detritus.

Storm Overflows.—These are mostly confined to intercepting sewers, and their uses are sufficiently apparent, but require to be properly adjusted to the service expected of them.

Outfalls.—The positions of these are mainly determined by the topography of the locality. When the hydraulic gradient cannot be raised to high water at the outfall without causing the flooding of cellars or even entire districts in the city, it becomes necessary to close the outlet by a penstock or tidal flap to prevent the tide-water from entering the sewer, which then acts as a storage tank until the tide recedes. This treatment is common in London, Hamburg, Dantzig and other places. In the case of a heavy rain-storm during the time when the sewers are locked against high tides, serious results are apt to follow if some such provision be not made.

Ventilation.—On this subject there are very decided and opposing views. Many different methods have been tried and none of them singly have satisfied all requirements. Mr. Hering explains the various methods with the objections to each, and describes the most common and effectual and least expensive method to be the man-hole shaft with iron grating and provided with pan, as mentioned under the head of man-holes, and he classes this branch of the subject as follows: "The conclusions which present themselves may now be stated as follows: The most economical and effective method of ventilation is by short shafts in the streets, placed at frequent intervals. The next best method is a free communication with the outer air through the soil-pipes of houses under the proviso that they are properly constructed."

Under the head of *maintenance of sewerage work* the following remark is worthy of consideration: "A striking contrast is observable between the average ordinary condition of the sewers in European cities and in America, and it is in this want of proper maintenance perhaps more than in any other point that our sewerage works have often failed to answer their intended purpose. If sewage were a uniform substance like water-gas or air, its conveyance through channels could be as readily accomplished as the water and gas supply of a city. But the sewer contains fluids, solids and gases of the greatest variety in bulk and weight, and sometimes in proportions which cause injurious conditions, or imperil the proper action of the sewers. Entire self-acting, therefore, cannot be relied upon. Occasional inspection is unavoidable in order to prevent serious obstruction, and artificial assistance in removing deposits becomes necessary from time to time." And this brings us to the methods in vogue for cleaning sewers.

Free Flushing by means of Sewage or Water from the City Supply.—Some cities, such as London, Berlin, Dantzig and Oxford, apply the city water by hose led into the man-holes; in others the sewage is dammed by flushing slides; in brick sewers flushing gates and penstocks are permanently built into the works for such use.

The intervals between these gates depends upon the grades and sizes of the sewers. It varies greatly, ranging from 300 to 5,000 ft., and the

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* When calculating the rainfall reaching the sewers to be ¼ in. in 24 hours, plus the sewage, the practice in England has been to use Eytelwein's formula of the form:

$$\text{Vel. in feet per sec.} = \frac{9}{10}\sqrt{\text{mean hydr. depth} \times \text{twice the fall in feet per mile.}}$$

frequency of the flushing depends upon local peculiarities, as in Berlin, every two weeks, and in England at intervals of from one to three months. Flushing by means of movable dams, as used in Paris, is more expensive than by gates, but when none of these methods will remove the obstructions, the cleaning by hand tools is resorted to, such as scrapers, brushes and other means of loosening the silt are drawn through the sewers, which may then yield to the operation of a flush by damming the sewage. When neither of these methods will answer, jointed hooks are sometimes inserted, which close when pushed into the pipe, but opens by a spring when pulled back and acts as a hoe. Whatever the means employed, it is done at regular intervals and in a systematic manner.

Cost of Construction.—This is tabulated for the cities examined, showing the cost per foot, as also the cost per inhabitant. By the latter method, in London, Berlin and Hamburg the cost varies from $11.25 to $16 per inhabitant. In Dantzig, the cost has been but $6.25, while in Liverpool it is as high as $19 per inhabitant. These differences, however, admit of explanation, and bring the cost per foot of sewer nearer to an equality in the various cities.

Cost of Maintenance.—In this Paris gives the highest figure, viz., 13 cents per foot; Vienna 9.3 cents. London averages 6 cents; Berlin 4.3 cents, and Hamburg 3.6 cents per foot; Frankfort 8.5 cents; Liverpool 3 cents. When the cost of maintenance is computed per inhabitant it shows in London at the rate of about 17 cents per head; Liverpool 14.7 cents; Berlin 10.1 cents; Hamburg 6.6 cents; Frankfort about 10 cents; Paris 13.5 cents, and in addition about 55 cents per head for removing the night soil. In Vienna, cleaning sewers, 7 cents per head, and removing night soil, 10.5 cents per head in addition. The last two cities show the great expense of dry removal over the water carriage.

Disposal of Sewage.—While our author touches upon this much-disputed branch of the subject with sufficient caution, yet his observations lead him to the following opinion: "The expectation entertained for a long time that town sewage could be converted into a valuable manure, which would not only pay for the conversion but render it profitable besides, has been given up, *save by a few parties interested in patent processes.* The general opinion held at present is that sewage must, beyond all other considerations, be disposed of in a way which is least injurious to the community; that a pecuniary profit cannot be looked for in every case, and that essential differences in topographical, physical; and geological conditions will require essentially different modes of treatment," and, as we might suppose would be the case, as the cost of land near a city generally increases in proportion to the size of the city, the cost of purification by the method of irrigation or filtration (sewage farms) per head of population, will, *cæteris paribus*, be more expensive for large than for small towns.

THE BENEFITS OF ENGINEERING SOCIETIES.

In commenting upon the last annual report of the Institution of Civil Engineers, a contemporary remarks that the perusal of said report—

> "Cannot fail to awaken feelings of satisfaction and pride among the members of the Institution to which they belong. The association is a powerful one, numerically and financially, and its usefulness to the profession cannot well be overrated. The advantages to be derived from the Institution building itself are, of course, limited to those who are able to make personal use of them, but the Transactions, which grow in size and value from year to year, are delivered at short intervals to members in all parts of the world, and who are thus more favored than the members of any other existing association. Foreign members, too, if they are debarred from attendance at the weekly meetings, and from the use of the reading-room and magnificent library, have full amends made to them by the improved status which their connection with the Institution bestows on them. If membership at home is a convenience, abroad it is a privilege; neither definition probably expresses exactly the benefits attached to the connection, though it defines accurately its relative advantages."

The above remarks apply to membership in the American Society of Civil Engineers, which is rapidly coming to be a measure of professional standing and which, with its increasing members, its valuable library and museum, and its contributions to engineering literature through its published transactions, must inevitably exert a very great influence upon the country at large through the planning and superintendence by its members of the great public works that are to be built during the coming years. This is certainly an era of awakening among engineers and surveyors, who, in numerous associations, are combining to secure the advantages of mutual aid in the discussion of professional papers and in the unity of effort for political recognition and consideration. The amount of valuable information already gained through the medium of local engineers' and surveyors' associations cannot be estimated, and with the impetus now gained the labors of these societies must eventually result in great good to the profession and to its patrons, the public. We feel, therefore, that engineers should be encouraged to unite with some association and especially aid in building up one strong, well-endowed central society, which will be for America what the Institution of Civil Engineers is to Europe.

PERSONAL.

Capt. T. S. Anderson, who has been Chief Engineer of the levees in Mississippi for the last six years, has been forced by impaired health to retire from his duties as such, and has moved to San Antonio, Tex. The Board of Mississippi Levee Commissioners at a recent meeting passed the following order and resolution: "It is ordered that the report of Chief Engineer T. S. Anderson be received and filed among the records of the Levee Board and be it resolved that in severing the relations which have so long and pleasantly subsisted with this engineer, the board bears most willing testimony to his thorough efficiency, combined with the highest order of personal character. Exemptions from ruinous overflows for a long period and a greatly improved system of levees attest his merit, and the painful necessity which severs his connection with the Board is regarded by us with sincere regret and deepest sympathy."

Gorham P. Low, C.E., recently on the N. Y. & N. E. R. R., has been appointed Superintendent Road Department of Elizabeth City & Norfolk Railroad, with headquarters at Norfolk, Va.

Geo. B. Francis, C. E., late an assistant in the City Engineer's office, Providence, R. I., has been appointed Assistant Engineer N. Y., W. S. & B. R. Ry., with headquarters at Poughkeepsie, N. Y.

Pensacola & Atlantic.—The engineer corps of this road is made up as follows: Chief Engineer, A. W. Gloster; division engineers, George B. Pickett, Colin A. Davis; resident engineers in charge of sections, John M. Cook, W. K. Atkinson, Frank Matthews, E. F. Jones, J. B. Billups, Paul Montfort, J. B. Clifton, O. H. Crittenden, A. M. Glassel; Assistant Engineer in charge of piling and bridges, Nesbit Winfield.

H. A. Sumner has been appointed Chief Engineer of the St. Louis, Keokuk & Northwestern and Chicago, Burlington & Kansas City railroads, with headquarters at Keokuk, Iowa. All business relating to track, bridges, buildings and water stations will be transacted through him. By order of Jno. W. Smith, General Superintendent.

Mr. Richard P. Morgan died at Dwight, Ill., Jan. 21, aged 92 years. He was probably the oldest civil engineer in the country, and had been employed in the survey and location of many important roads, including the location of the Western (now Boston & Albany) Railroad in Massachusetts. He retained his interest in his profession to the last, although his great age had deterred him from active work for several years past. He leaves two sons, Col. Richard Morgan, of Bloomington, one of the first board of Railroad Commissioners of Illinois, and Mr. George Morgan, of Chicago, who are well-known engineers.

The Hon. Clarkson N. Potter, famous as a politician, statesman and Democratic leader, died in this city on the 23d inst. He was sick but a few days, although his health had not been robust for several years. His life has been passed largely in politics and public affairs. His greatest prominence was attained in 1876, as a member of Congress and a member of the Electoral Commission, and afterwards as chairman of the committee to investigate the cipher dispatches. He was born in Schenectady, N. Y., in 1825; graduated at Union College, of which his grandfather, Rev. Eliphalet Nott, was president, and his father, Bishop Alonzo Potter, was vice-president, in 1842; graduated at the Rensselaer Polytechnic Institute as a civil engineer in 1843, and was a surveyor in Wisconsin; studied law in that State, and after coming to the bar commenced the practice of his profession in New York City in 1847; held no public offices, but was engaged in many important cases; was elected to the Forty-first Congress, and was re-elected to the Forty-second Congress as a Democrat, and again in 1876, as we have stated. He was a high-minded, courtly man, and of the best type of political leaders.

Charles Stroud, of Canastota, died of heart disease at Syracuse on the 20th, aged 82. He was a large contractor when the Erie Canal was enlarged.

C. E. Sprague, C. E., late of the B. & A. R. R., Springfield, Mass., has been appointed Assistant Superintendent of Bridges and Buildings on the C. M. & St. P. R. R., with headquarters at Minneapolis, Minn.

Prof. Geo. L. Voss, C. E., of the Institute of Technology, Boston, on Thursday evening delivered a lecture before the Society of Arts in that city upon the "Inspection of Public Works," with special reference to the present method of building and inspecting railroad and highway bridges in the United States.

Alex. Wadsworth Longfellow, of Portland, Me., obtained the highest honors of the seven American architects graduated this year at the Ecole des Beaux Arts at Paris.

Atlantic & Pacific Railroad Company (Western Division).—The following circular has been issued by Acting Engineer Kingman, under date of Jan. 2, 1882: "R. N. Billings is hereby appointed Resident Engineer, with head-quarters at Cranes, N. M., to take charge of track, bridges and buildings, from Albuquerque to the Front; to lay out, measure and estimate all contract work, and superintend the same, that may be necessary for the improvement and protection of the road-bed. The Master Carpenter, road masters, construction trains and water service will be under his direction and subject to his orders. Their check rolls and accounts must be sent or handed to him; and no accounts from his jurisdiction will pass this office without his approval. He will be expected to look after the work and see that men intrusted to responsible positions do their work faithfully, and hold those under them to their duty. W. A. Drake is hereby appointed Resident Engineer, with head-quarters at Williams, Arizona, to take charge of construction from section 306, at Padre Cañon, to section 554, at the Colorado River. The several division engineers (except T. F. Richardson) will be subject to his orders. He will be required to certify to all vouchers, estimates, check rolls and accounts of the division engineers in his charge; to examine their work and notes, and to see that they are correct before being sent to this office; to see that division engineers give grades and centers, and attend to their other duties faithfully. The follow-lowing division engineers, who have heretofore been employed by Mr. Holbrook, are continued in their several places: T. F. Richardson, to have charge of the masonry and grading from and including Cañon Diablo to and including Padre Cañon. All matters pertaining to that work will be under his charge, and he will report direct to this office. C. F. Lawton, in charge of division from section 306 to 325 inclusive; John McGuire, in charge of division from section 336 to 351 inclusive; Geo. S. Van Law, in charge of division from section 352 to 374 inclusive; Horace Ropes, in charge of division from section 375 to 384 inclusive; J. M. Clark, in charge of division from section 385 to 4 0 inclusive; F. W. Meeds, in charge of division from section 411 to 436 inclusive; C. S. Henning, in charge of division from section 437 to 460 inclusive; H. C. Todd, in charge of division from section 461 to 476 inclusive; Albert Drake, in charge of division from section 476 to 492 inclusive; W. G. Middleton, in charge of division from section 493 to 510 inclusive. All division engineers (except T. F. Richardson) are required to report to W. A. Drake, Resident Engineer. All orders from this office will be transmitted through him, except in cases of emergency, when they will be sent direct. All division engineers are requested to send a weekly report to this office, giving information in regard to the progress of the work, number of men employed and points of interest. Write short, comprehensive letters, pointing out any defects, so that the Chief Engineer can act intelligently in regard to the work. H. B. Hedges, William S. Steel and R. R. Swisher are now appointed Division Engineer's assistants, to remain in their several places until further notice. Alfred Gregory, who has heretofore been in charge of the bridging at the Front, will remain in charge and complete the repairs of bridges heretofore contemplated, and report at this office. William F. Hill, who has been acting as assistant to R. N. Billings, will report to him until further notice. A. W. Phelps, who has been in charge of the Material Yard at Cranes, N. M., will continue in that place; make weekly reports as heretofore, and send one copy of the same to F. W. Smith, General Superintendent, and one copy of the aforesaid report to this office. Ralph Halloran, who has heretofore occupied the position of Commissary, will continue to act in that capacity. All accounts, vouchers and contracts with freighters, a weekly statement of about what is on hand, together with an occasional letter in regard to the business, are to be sent to this office. J. C. Miner will continue to inspect ties and timber, and report to this office. Walter C. Sanders, who has heretofore acted as Chief Clerk, will continue in that capacity. C. W. Sanders, who has heretofore acted as Office Engineer, will continue as such. Wm. McAdams, A. C. Aldrich, F. W. H. Cutter and C. J Quitel, who have been draughtsmen in the office, will continue in their several places. Resident Engineer R. N. Billings is authorized to issue passes at his discretion to the employés of his department."

OBITUARY.

We regret to announce the death at Milwaukee, on the 25th inst., of MOSES LANE, for many years City Engineer of that city. Mr. Lane was born in Northfield, Vt., in 1824, and graduated at the Vermont University. He adopted the profession of a teacher, and for several years was engaged as principal in various seminaries of learning. Subsequently adopting the profession of civil engineering, after a brief service in railroad surveys and construction in Vermont and New Hampshire under I. C. Chesbrough, C. E., he was appointed principal assistant to Mr. Kirkwood, from the commencement of the construction of the Brooklyn Water-works in the summer of 1856 to their completion, and was appointed Chief Engineer in 1862, which position he held until May, 1869, when the inauguration of important public works at the West opening a wider field for usefulness, he removed to Milwaukee, the extensive water-works of which city he designed and executed, and, with the exception of short intervals, continued as its city engineer until the time of his death. Aside from the construction of this and other works in the Northwest, he was largely employed as consulting engineer on important undertakings connected with city drainage and water-supply throughout the country from New Orleans, La., to Boston, Mass.

Mr. LANE was noted for extreme simplicity of manners and modesty of deportment, and averse to making himself the central figure in any company, frequently doing injustice to himself rather than in the slightest degree to encroach upon the claims of others. To a casual acquaintance, this might appear as a defect almost amounting to weakness; but to those who knew him, nothing could be further from the fact than such an estimate of his character, possessing, as he did, in no common degree, the true elements of a noble manhood, a thorough contempt for shams and falsehood, and fearing nothing for himself when in the way of truth and duty. In this respect it could be said of him that he possessed amiability without weakness, and strength without aggressiveness.

A member of the American Society of Civil Engineers, and Vice-President of the Society of Engineers of the Northwest, his professional reputation constitutes a part of their record, and his various labors in his profession will receive from them due notice; but his qualities as an engineer, high as they were acknowledged to be, were by no means the most striking points of his character, and it is to be hoped that whoever may be assigned the task of making out his professional record may have enjoyed the pleasure of social intercourse with him, that they can, to a limited extent at least, do justice to his many sterling qualities. *Requiescat!*

ENGINEERS' SOCIETIES.

ANNUAL MEETING OF THE A. S. C. E.

The following is a corrected list of the names of those who attended the meeting on Wednesday, Jan. 18: Lyman Bridges, Chief Engineer California Central Railway; Theodore N. Ely, Pennsylvania Railroad; Octave Chanute, Chief Engineer Erie Railroad; Sanford Fleming, ex-Chief Engineer Intercolonial & Canada Pacific Railroad, of Ottawa, Can.; Chancellor of the Queen's University, Kingston, Can.; David Reeves, Phœnix Iron Company, Philadelphia, Pa.; Heny G. Morse, of the Morse Bridge Company, Youngstown, O.; Joseph M. Wilson, Engineer of bridges and buildings of the Pennsylvania Railroad; Joseph Waltz, City Engineer of Dayton, O.; Charles Kellogg, of the Kellogg & Maurice Bridge Works, Athens, Pa.; F. C. Prindle, United States Navy; William H. Bradley Superintendant of Sewer Construction, Boston, Mass.; Martin Coryell, Lambertville, N. J.; Charles G. Darrach, First Assistant Engineer of the Philadelphia Water-works; Gen. Theodore G. Ellis, Engineer on the Government improvements on the Connecticut River, Hartford, Conn.; William P. Shinn, New York City; William H. Searles, Engineer of the West Shore Road, Newburg, N. Y.; Marshall M. Tidd, Boston, Mass.; Charles E. Fowler, City Engineer, New Haven, Conn., and Albert B. Hill, his first assistant; Gen. William Sooy Smith, Chief Engineer of the Hudson River Tunnel; Capt. Otto E. Michaelis, Ordnance Corps, United States Army; William Metcalf, Crescent Steel Works, Pittsburgh, Penna; Erasmus D. Leavitt, Jr., Chief Engineer Calumet & Hecla mine, Lake Superior, Mechanical Engineer of Lynn & Lawrence (Mass.) Water-works and constructor of the sewerage pumping-engines of Boston, Cambridgeport, Mass.; Samuel M. Gray, City Engineer, Providence, R. I.; David M. Greene, Director of the Rensselaer Polytechnic Institute, Troy, N. Y.; Clark Fisher, Trenton, N. J.; Theodore Cooper, Naw York; L. L. Buck, Central Railroad of New Jersey, New York; Col. W. H. Paine, Francis Collingwood, C. C. Martin and G. W. McNulty, Engineers East River Bridge; Geo. W. Dresser, *American Gas Light Journal*, New York; John Bogart, Secretary of the Society; J. J. R. Croes, Treasurer of the Society; Alfred P. Boller, Chief Engineer Albany & Greenbush Bridge; George H. Frost, ENGINEERING NEWS; Thomas C. Clarke, Phœnixville Bridge Works; George S. Morison, Chief Engineer Bismarck Bridge N. P. R. R.; Henry D. Blunden, First Assistant Engineer Erie Railway; William H. Wiley, of Wiley & Sons, Publishers; Henriques Harris, Engineer Manhattan Beach Railway; Jas. McCrea, Supt. N. Y. Div. Pennsylvania R. R.; Julius W. Adams, Past President A. S. C. E., ENGINEERING NEWS; E. S. Chesbrough, Consulting Engineer New York City; Thomas M. Cleeman, Philadelphia; Joseph P. Davis, Vice-President and Chief Engineer Metropolitan Telephone Co., New York; Prof. T. Egleston, Columbia College, New York; Charles E. Emery, Engineer New York Steam-Heating Co., New York; Bryant Godwin, New York City; Wm. H. Grant, New York City; Wm. E. Hutton, New York; Gabriel Leverich, Brooklyn; Charles Macdonald, President Delaware Bridge Co.; Cook Talcott, Newark, N. J.; Charles D. Ward, Jersey City; W. E. Worthen, New York City; Charles Ward Raymond, Assistant Engineer Hudson River Tunnel; Sebastian Wimmer, New York City; Edward R. Andrews, New York City; John Avery, Assistant Engineer Bureau of Sewers, Department Public Works, Naw York City; Wm. M. Allaire, New York City; T. H. Aldrich, Birmingham, Ala.; N. H. Atwood, Jersey City, N. J.; Prof. Cleveland Abbe, Washington, D. C.; H. Bissell, Master of Maintenance Eastern Railroad, Salem, Mass.; E. W. Bowditch, Boston, Mass.; Henry R. Bradbury, New York City; Van Brunt Bergen, Assistant Engineer Board of City Works, Brooklyn, N. Y.; Charles O. Brown, New York City; James A. Burden, Burden Iron Works, Troy, N. Y.; William D. Bullock, Assistant City Engineer, Providence, R. I.; Thomas J. Bush, Lexington, Ky.; H. Wadsworth Clarke, Engineer in charge New York and Pennsylvania Boundary Survey, Syracuse, N. Y.; Prof. A. G. Compton, Naw York City; T. E. Brown, Jr., New York City; Prof. William H. Burr, Rensselaer Institute, Troy, N. Y.; E. A. Doane, Oswego, N. Y.; Edward B. Dorsey, New York City; S. Clarence Ellis, Assistant City Engineer, Boston, Mass.; N. W. Ellis, Manchester, N. H.; Robert Escobar, Delaware Bridge Company, New York City; Charles H. Fisher, Chief Engineer New York Central & Hudson River Railroad, Albany, N. Y.; C. F. Findlay, London, Eng.; Albert Fink, Past President A. S. C. E., New York City; M. N. Forney, *Railroad Gazette*, New York City; Charles E. Goad, Montreal, Can.; George S. Greene, Jr., New York City; E. E. Glaskin, London, Eng.; S. S. Haight, Topograhical Department, New York City; W. G. Hamilton, New York City; A. R. Haddock, New York City; Geo. E. Harding, Chief Engineer New York & Brighton Beach R. R., New York City; B. D. Hasell, General Agent, Great Southern Line, New York City; Wm. A. Haven, Engineer in charge Buffalo Division N. Y., L. O. & W. R. R., Buffalo, N. Y.; Walter Katte, Chief Engineer N. Y., Ontario & Western R. R., New York City; A. P. Kirtland, Blairsville, Pa.; T. H. McKenzie, Southington, Conn.; T. C. McCollon, New London, Conn.; W. H. Martin, San Francisco, Cal.; J. McNulty, Brooklyn, N. Y.; N. Morton, Plymouth, Mass.; J. G. Macklin, Ottawa, Canada; Arthur Macy, New York City; Prof. H. B. Nason, Troy, N. Y.; Isaac Newton, Chief Engineer Croton Aqueduct, New York City; James Owen, Chief Engineer Essex Board, Newark, N. J.; Chas. Paine, Gen. Manager New York, Ontario & Western R. R., New York City; J. C. Platt, Jr., Waterford, N. Y.; J. G. Sanderson, New York City; Robt. P. Staats, New York City; C. V. Smith, Chief Engineer Manhattan Gas Light Company, New York City; S. H. Shreve, Chief Engineer Elevated R. R., Brooklyn, N. Y.; W. W. C. Sites, Jersey City, N. J.; Albert Spies, New York City; A. M. De Souza, Brazil; Joseph R. Thomas, Brooklyn, N. Y.; Prof. R. H. Thurston, Stevens Institute, Hoboken, N. J.; E. B. Van Winkle, Director Topographical Department Public Works, New York City; Robt. Van Buren, City Engineer, Brooklyn, N. Y.; Ashbel Welch, President A. S. C. E., Lambertville, N. J.; John A. Wilson, Philadelphia, Pa.; H. F. Walling, U. S. Coast Survey, Washington, D. C.; Prof. Wm. Watson, Boston, Mass.; L. B. Ward, Jersey City, N. J.; T. J. Whitman, Water Commissioner St. Louis, Mo.; Prof. D. Volson Wood, Stevens Institute, Hoboken, N. J.; James P. Bogart, Hartford, Conn.

THE MICHIGAN ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.

The second annual meeting of the above Association was held at Lansing on the 12th, 13th and 14th insts. About fifty members were in attendance. Prof. C. E. Greene read a paper on "Deep-Water Foundations;" Prof. R. C. Carpenter read one on "Draining Engineering;" H. C. Pearsons, on "Correction of Compass in Ships;" G. L. Pearsons, "Water-Works for Small Towns," and J. H. Leavenworth, on "Questions of Practice." Problems relating to subdivision of a section, lost corners, etc., etc., were discussed. Financially the Association is in good condition, there being over 100 paying members. The proceedings of the meeting, including the papers read, will soon be issued in pamphlet form, and will be for sale at ten cents per copy. The officers' elected for the following year are: President, Prof. Charles E. Greene, University of Michigan, Ann Arbor; Vice-Presidents, James Sanderson, Detroit; J. K. Yocum, Waterloo; C. M. C. Swoon, Jackson; F. Hodgman, Climax; H. C. Pearsons, Ferrysburg; H. D. Bartholomew, Lansing; J. J. Watkins, Lapeer; C. F. Gould, Saginaw; George E. Steele, Elk Rapids; Secretary and Treasurer, Prof. R. C. Carpenter, Lansing; Executive Committee, William Donovan, Lansing; Burton Kent, Adrian; M. Bullock, Howell; President and Secretary, *ex-officio*.

Special committee on manual continued as last year.

Resolutions of respect were adopted in regard to the late Lyman Mason, engineer on the Mackinaw Division of the Michigan Central Railroad.

It was voted to hold an exhibition of surveyors' and engineers' instruments in connection with the next regular meeting.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS NO. 1,523 CHESTNUT STREET, PHILADELPHIA, PA.

Record of regular meeting, Jan. 21, 1882, President Rudolph Hering in the chair, 16 members present:

A paper by Prof. W. S. Chaplin, on the "Relative Tensile Strengths of Long and Short Bars," was presented, on his behalf, by Prof. L. M. Haupt. The object of this paper is to prove that long bars are, on the average, weaker to resist tensile stress than short bars of the same material and cross section, and to show how the reduction in strength may be found when the proper experiments have been made on the short bars.

The Secretary presented a correspondence, in the year 1889, upon the subject of street paving, between the Chairman of the Committee on Public Highways, of the city of Philadelphia, and Mr. Thomas U. Walter, Honorary Member of the Club, who was then in Europe, and was requested to furnish information as to the paving of European cities. His letter treats of the ordinary cobble-stone, wooden, granite-block, cobble-stone with flag-stone tramways, McAdamized and natural and artificial asphaltum roadways, and is remarkable as exhibiting how much was known upon this subject over forty years ago and how little we have profited by it in Philadelphia.

Mr. D. H. Shedaker submitted an extract, giving account of an exhibition of electric lighting in Trafalgar Square, London, in 1848. The results were so satisfactory that the writer considered that "after a short time we should not be surprised to hear of the total extinction of half the gas companies in the kingdom."

Mr. Charles A. Ashburner explained some difficulties which have been encountered in the anthracite coal mines of Schuylkill County, where the coal beds have been "pinched out" and lost, but which have afterwards been found by driving tunnels at right angles to the strike of the beds and away from the center of the basin. This irregularity of structure seems to have been produced by a folding of the strata at right angles to the strike, by a force exerted in the direction of the basin.

HOWARD MURPHY, Secretary and Treasurer.

* * *

THE RAIL MARKET.—The *Iron Age*'s Philadelphia report says of steel rails: "It is difficult to report this branch of business correctly. There is a general impression that a good many parties have bought more than they are likely to require, and that resales or postponements of deliveries will have to be arranged. Manufacturers in this vicinity assure us that so far as they are concerned they have more buyers than they can accommodate, and that sales at $58 to $60 can be effected without any difficulty whatever. Iron rails are quoted at $48 per ton at mill for heavy rails and $50@$53 for light sections. No large transactions are reported. Spikes are unchanged at $3.15@$3.25 per 100 lbs.; fish-plates $2.60, and track-bolts $3.75@$4.25. Steel blooms are quoted at $46@$46.50 per ton, duty paid, with unsettled market and downward tendency. Old iron rails are a little more active but irregular, at, say, $29@$31.50 per ton in Philadelphia."

STADIA SURVEYING.

Written for Engineering News.

BY JAMES P. ALLEN, U. S. ASST. ENG., CHARLESTON, S. C.

The method of surveying in which distances are determined from the space covered on a rod by parallel wires in the transit is known to all engineers, although few, comparatively, have given it any attention.

The Coast Survey and the Lake Survey have both used it. It is also employed by the U. S. Engineer Corps in their surveys for the improvement of rivers and harbors. But its use in ordinary engineering fieldwork is limited.

The following notes are offered in advocacy of a broader field of usefulness for the stadia method:

We are concerned at present only with the practical portion of the subject. The following formulæ by Prof. S. W. Robinson embody all of the corrections, and give results which are theoretically accurate, or so nearly so that no error in practice can result from their use. The rod is supposed to be held vertically.

$$H = \frac{R'}{2\,R}(B - c - f)\ \sin.\ 2\,V + (c + f)\ \sin.\ V\ (1)$$

$$D = \frac{R'}{R}(B - c - f)\ \cos.^2\ V \pm (c + f)\ \cos.\ V\ (2)$$

where

R' = any distance as read by the stadia.
B = the length of a measured base.
R = the reading of the stadia on that base.
V = the angle of elevation or depression.
c = the distance from center of object glass to center of instrument.
f = the principal focal length of the object glass.
H = the corrected height of the point sighted at above the axis of revolution of the telescope.
D = the horizontal distance of said point from center of instrument.

These formulæ may be placed under the following forms:

$$H = \frac{R'}{2\,R}B\ \sin.\ 2\,V - (c+f)\ \sin.\ V\left(\frac{R'}{R}\cos.\ V - 1\right)(3).$$

$$D = \frac{R'}{R}B\ \cos.^2\ V - (c+f)\cos.\ V\left(\frac{R'}{R}\cos.\ V - 1\right)(4.$$

For a great deal of work, to which the stadia method is adapted, the whole of the later portion of these expressions may be neglected, giving the following abbreviated formulæ:

$$H = \frac{R'}{2R}\ B.\ \sin.\ 2\ V,\ \text{and}\ D = \frac{R}{R}\ C\ \cos.^2\ V.$$

The value of $(c + f)$ varies for different instruments. It may be assumed to be 1.4 ft. The engineer can, however, readily determine it for himself by measuring the distance from the object glass, when focused upon a distant object, to the adjusting screws of the diaphragm, and the distance from the object glass to the center of the instrument. The first measurement gives the value of f, and the other that of c. Since R is generally made equal to B, the formulæ above reduce still further to

$$H = \frac{R'}{2}\ \sin.\ 2\ V\ (5)\ \text{and}\ D = R\ \cos.^2\ V\ (6).$$

It is possible to do fair work upon ordinarily level ground with any engineers' transit having stadia hairs introduced, but for general work it is imperative that the instrument have a vertical limb.

To put in the extra spider hairs necessary for stadia readings, the diaphragm must be taken out, and the hairs stretched on separately. Great care should be exercised in stretching the hairs all that they will bear, otherwise they will change in damp weather. A pair of spacing-dividers with a bit of wax on each point is useful for this purpose. It is recommended to breathe upon the hairs while stretching.

The hairs should be carefully spaced on the diaphragm so as to secure a convenient rod. It is best that the rod should have about 1 ft. for a distance 100 ft. Now, if X represent the distance from the optical center of the object glass to the stadia hairs, when the instrument is focused for 100 ft., we have

$$a\ (\text{in feet}) : 100\ \text{ft.} :: x\ (\text{in inches}) : 12$$

$$\therefore x = \frac{12\,a}{100} = 0.12 \times a = \text{space in inches}$$

between stadia wires on diaphragm.

It will be understood that we do not in this manner fix the graduation of the rod, which must be determined by careful experiment after the hairs are in.

The rod should be about 12 ft. long, of inch stuff well seasoned. For convenience of transportation it may be hinged in the middle, so that two parts of the face may fold inward. A short plumb-bob upon the back of the rod might contribute to accuracy, but it is not considered essential.

The design for the graduation of the rod is largely a matter of choice. Fig. 1, which is believed to have originated with the U. S. Survey of the Northern Lakes, is probably the best for general purposes. Fig. 2 shows a rod reading to feet, which, however, is only suited to short distances.

The ordinary method of determining the length of a 100-foot division on the rod is as follows:

A loose line of 1,000 ft. is measured very carefully on level ground. Over one extremity of this base the instrument is placed, and the rod is held at the other. By the use of temporary card-board targets the space covered by the stadia hairs is determined. This is sub-divided into ten parts. The pattern is penciled on by using a stencil, and the figures are afterwards painted black. B and R in the formulæ are thus made equal, and each is equal to 1,000 ft.

In the foregoing only the stadia transit with fixed wires has been considered. For many reasons an instrument with the wires adjustable is to be preferred. In fact, the advantages of such an instrument greatly outweigh the disadvantages, largely imaginary, which are attributed to it.

FIG. 1.

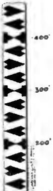
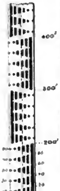


Fig 3.

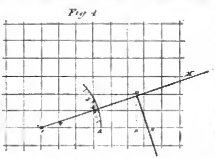
FIG 2.



The ordinary arrangement for making the adjustment is not a good one, and this may account for the prejudice against movable wires. The stadia hairs are not upon the diaphragm, but are carried, one each, upon two separate slides moved independently, each by a single screw. It is thought that this arrangement will lose its adjustment easily, and serious error may result. The writer has used an instrument in which one of the stadia wires is upon the main diaphragm and not movable separately, while the other is upon a diaphragm of its own, adjusted by loosening the upper or lower screw, as the case may require, and tightening that opposite. This instrument very rarely gets out of adjustment.

Of the advantages of an adjustable diaphragm, it is only necessary to mention at this point the greater ease with which the rod and instrument are adapted to each other.

Fig 4



The rod is at once laid off with the desired figure, 1 ft. representing 100 and painted. Then, upon a measured base, the instrument is adjusted to it.

Should one of the hairs break, the engineer can himself put in another and adjust to the rod as at first. In the case of fixed wires the rod must be painted over, and graduated anew, or a troublesome correction applied to every stadia reading by a special scale or otherwise.

The simplest form to which our formulæ reduce (5) and (6), may not be considered sufficiently accurate for some classes of work.

Different plans have been suggested for obtaining more accurate results without making the computation by the formulæ (1) and (2).

In a book of tables by Alfred Noble and W. T. Casgrain, U. S. Assistant Engineers, published in 1871 by the Engineer Department of the Government, the correct distance and height are obtained as in a traverse table, for values of the vertical angle V to minutes.

These tables are based upon formulæ (1) and (2), the values of $(c+f)$ cos. V and $(c+f)$ sin. V, appearing as additional corrections in separate columns. In another book of "Tables showing Difference of Level" "and for Horizontal Reductions," by J. A. Ockerson and Jared Teeple, assistant engineers, U. S. Lake Survey, heights are given for each 10 meters stadia reading; and, for the intermediate meters, the additional elevation is obtained from the common difference at the right of the page. This is Table I.

Table II. supplements Table I. giving the means of getting heights for greater readings than are given in Table I.

Table III. starts "to reduce reading on a slope to horizontal distances" for each degree and minute from 2° to 11°.

The following is the method suggested for graduating the rod in order to diminish the error due to $(c+f)$:

Measure a base, marking the 100, 200, 300, and 400 meter points. Set the transit over the zero point. Hold the rod at the first point marked, and determine the space covered by the wires (which are supposed to be fixed). This space is measured. Next hold at 200, determine the space on the rod, measure it as before, and so on for all points to the 400 meters. Then in the words of the book, "it is best to distribute $(c+f)$, which is small, among the several determined distances. Hence take for the length of each 100 meters space the mean of all the 100 meter spaces determined. That is to add together the length of the 100, 200, etc., spaces, and divide by the number of 100 spaces determined. A little more weight should perhaps be given to the short distances as the targets are more distinct."

It would seem as though this method was equivalent to graduating the rod upon a base shorter than 400 meters in the way already described for an instrument with fixed wires, the error due to $(c + f)$ still obtaining.

It will be observed, however, upon studying the formulæ, that this error is less the nearer the reading approaches the length of the measured base, and a short base may sometimes be better than a long one, if $(c + f)$ be neglected.

With adjustable wires it is possible to select a length of base, greater or less, as we may expect our readings to be greater or less. In other words, if a survey is to be made where the readings will be short, adjust upon a short base, and vice versa, selecting for the length of base, as nearly as may be, a mean of the expected readings. Since we can seldom predict either long or short distances exclusively, but may have both very long and very short, this plan does not recommend itself for general work.

The direct reading of the stadia rod for horizontal distances on level ground and formulæ (5) and (6) for measurements on slopes are generally close enough. The tables are not popular on account of the labor which they entail.

The following plan for graduating the rod almost obliterates the error in question, and does not materially increase the labor of working up the notes, over and above that which is essential to any application of this method.

We assume, as is ordinarily done, $B = R$, and suppose the length of our measured base B to be infinite. From the formulæ (3) and (4), we have

$$H = \frac{R'}{2}\ \sin.\ 2\ V + (c + f)\ \sin.\ V.$$

$$D = R'\ \cos.^2 V + (c + f)\ \cos.\ V.,$$

which we propose to write

$$H = \left(\frac{R' + (c + f)}{2}\right)\ \sin.\ 2\ V\ (7),\ \text{assuming}\ (c + f)\ \sin.\ V = \frac{(c + f)\ \sin.\ 2\,V.}{2}$$

$$D = [R' + (c + f)]\ \cos.^2 V\ (8);\ \text{assuming}\ (c + f)\ \cos.\ V = (c + f)\ \cos.^2 V.$$

Upon a level (8) becomes $D = R' + (c + f) = R + 1.4$

$$\therefore R' = D - 1.4.$$

Suppose we then measure a base of 501.4 (rather than 1001.4, as giving a more distinct view of the rod). Make the instrument read 500 ft. exactly upon this base, as already described for adjustable wires or fixed, as the case may be. To each reading of the rod we have now to add 1.4 ft., a mental operation which can hardly be considered burdensome. We thus obtain the correct distance upon a level.

If the vertical angle be read, formulæ (7) and (8), which are equivalent to (5) and (6), should be used.

For some other value of $(c + f)$ than 1.4 ft., we will have to substitute this value for 1.4 in the process.

In describing the field work, although, as has been already said, some work can be done with an ordinary transit, we prefer to assume the use of a good stadia transit. This should have a clear telescope of comparatively large magnifying power (a very important feature of a stadia transit), a long bubble under the telescope, and a vertical arc of 60°, graduated to read 30° in elevation and 30° in depression. The horizontal graduation should be adopted to measuring angles to the right or left from 0 to 180°, and should also be numbered from 0 to 360°. The stadia rod is supposed to be graduated 1 ft. to 100 ft., and is consequently a self-reading level rod.

The field party need not consist of more than two men, besides the observer, and often a single stadia man will be all that is required. Axemen and boatmen in addition will sometimes be demanded by economy and the necessity for rapid work.

In the surveying of rivers the stadia method is especially useful. The readings being mainly horizontal, no reduction of the notes by formulæ is necessary, if (c + f) be neglected.

It is customary to run a chain line on one bank, or to triangulate, in order to obtain a base line for the survey. The stadia lines are closed upon points so fixed at convenient intervals. The method of carrying the azimuth is usually adopted, all angles referring to the true or magnetic meridian.

The topography of the banks and details are run in by taking bearings to points and stadia distances.

In carrying forward the line, clearing can be avoided where the width is not too great by crossing from side to side (see Fig. 3).

It will be seen that the economical working of the method will depend largely upon the judgment of the observer, and of the stadia run in the selection of points.

If it be desired to read a distance greater than that corresponding with the length of the rod, or if a portion only of the rod can be seen, the distance given by the upper wire and the center or original horizontal wire should be read, and then that of the center and the lower wires. The sum of these two readings will be the distance. Long distances, however, are undesirable. Sometimes it is required to survey a stream or a slough hastily, and compass bearings are sufficiently close. Let the transit at a Fig. 3 take the bearing by the north end of the needle and the stadia distance to *b*. Now set up at *c*, take the bearing by the south end of the needle and the stadia distance to *b*, and read the north end of the needle and the distance to *d*. One rodman can be kept upon each bank, and only occasionally will the observer need to cross. The field notes are written as though the instrument had been set at every point. It is to facilitate this that the south end of the needle is recommended to be read from c to *b*. Intermediate readings are taken to give the shore line, sounding stakes and all the details. But for the space required we could multiply the uses of the stadia instrument in hydrographical surveying.

For contour lines and the topography of hillsides, different plans suggest themselves. A number of points may be located, and their heights determined, at each setting of the instrument, by reading the vertical angle as well as the bearing and distance, and the contours sketched by the eye upon the field sketch; or cross-sections may be made at suitable points, perhaps several at a setting, or a combination of both of these plans. The line of collimation of the telescope should always be directed upon the same point of the rod for obtaining the vertical angle. If considerable accuracy is desired, the levels can be carried forward by the use of the bubble under the telescope, which should be carefully adjusted by the two-peg method. The stadia rod serves as a level rod.

For irrigating ditches or pipe lines very excellent and economical preliminary surveys can be made with the stadia, the alignment, levels and topography being obtained with a single instrument and a small party. If compass bearings will answer, it is only necessary to set at every other angle.

With the vertical arc or the bubble it is easy to fit any grade to the ground.

The writer once had occasion to run a trial line for an irrigating ditch of 1½ miles. It was done with the stadia and a single man in about four hours. Running over the ground afterward with transit and level, the location differed very slightly from the preliminary line, and the levels checked within a few tenths.

We touch upon the subject of surveys for railroads by the stadia with some hesitation, not because we have any doubt as to the utility of the method, but because our experience in railroad work is limited. Hoping that this admission will serve as an apology for possible blunders, we unhesitatingly recommend stadia surveying for the preliminary line, including topography, and for trial lines.

The party may consist of an assistant engineer, an instrument man, three stadia men and three axemen.

The assistant engineer takes general direction of the work, and does the sketching. The instrument man reads the angles and stadia distances, takes the levels, and keeps all of the notes of his own work.

Each stadia man has his axeman. In some country a brush hook is an excellent substitute for an axe. One stadia man gives elevations along the line as designated by the assistant engineer, taking points wherever they may be required for an accurate profile. Another stadia man gives cross-sections at proper intervals, by holding the rod at a succession of points on a line, as nearly as may be perpendicular to the line of the survey. The third takes up houses, fences and other details for topography. Often the third stadia is superfluous. No. 1 can do his work, and two rods will generally keep the observer busy. No 2 works on the back course, so that he can give back sight for both transit and level work. No 1 gives the foresights. The observer reads both the angle and distance to the new station. The latter he can check when he sights back upon No. 2.

It will hardly be necessary to remind the reader that the stadia rod is supposed to be a self reading level rod, and that the bubble under the telescope enables us to take fairly accurate levels. The reading of the vertical angle will enable us to determine the heights of points which are too far above or below the level line at any setting to be determined in the ordinary manner of leveling.

When No. 1 reaches the proper point, as determined from the length of the B. S., by a signal, the observer directs a turning point to be put in, which is done by the axeman, who also marks its position with a tall stake. When No. 2 reaches this, he holds upon it, the instrument being now at the next station, and the B. S. is read—also the distance. The observer has it in his power generally to secure equal sights. Otherwise long sights must be corrected for curvature and refraction.

The following form of field notes is suited to this class of work:

FOR LEFT HAND PAGE.

Sta. or point sighted at.	At Sta.			Vertical angle.	Remarks.
	Bearing (or Angle).		Distance, as read.		
	Ver. A. (or Rt.)	Ver. B. (or Lt.)			

The stations, or points where the transit is set up, can be distinguished by the prefixing of a symbol or the abbreviation "Sta." from the points whose position and elevation alone we wish to obtain. The "Stas." should be numbered consecutively, and the points may run 1, 2, 3, etc., for each "Sta." without other designation.

With the method of carrying the azimuth both veniers are read. The engineer may prefer to read angles to the rt. and lt., however. The record for either case can be made as indicated. The distance is the reading of the stadia; any corrections to be applied afterward. Angles of elevation and depression may be distinguished by prefixing + or — sign. In the column "Remarks," the point sighted at should be described briefly, as, for example, "Fence corner," "N. W. corner house," "center wagon road," "for contours," etc.

Upon the right-hand page we would have level notes in the ordinary form, keeping the F. S. and B. S. upon the same line as that which the bearing and distance of the point occupy on the left-hand page.

If there be a great many points required, the instrument man should have a recorder.

Two serious difficulties present themselves.

If the ground be very densely wooded or covered with underbrush, it is difficult to read the rod. But the same difficulty exists to a greater or less extent in carrying any line over such ground. The stadia line can sometimes be made to pass through vistas or partial clearings, and offsets made into the thicket, toward and across the line of the proposed road. It will be remembered in this connection that it is not necessary to see the whole rod, except for very long distances. Two and a half feet of the rod will enable us to read 500 ft. very nearly (exactly, if the upper and lower wires are equally distant from the center wire).

The other difficulty is the increased labor of calculating the excavation and embankment where the elevations are not taken at 100 ft. intervals. To this we say that we have all the data for a fairly accurate profile, and, if this be properly prepared, we cannot see why, for preliminary work, the cuts and fills may not be taken from it directly and the cross stations from the contours. The advantages are these. The work is all under the eye of the assistant engineer and is accomplished at one operation. The party is only about one-half as large, and we believe that with a little practice the survey can be pushed quite as rapidly as by the ordinary method. The problems of avoiding obstacles, crossing streams, etc., are greatly simplified. For reducing that portion of the notes of any stadia survey, where the vertical angle has been read the tables mentioned may be used if they can be obtained, or the corrected distance and height can be calculated by the formulæ.

The following is a very convenient graphical construction for formulæ (5) and (6), or (7) and (8): A piece of cross-section paper is smoothly stretched upon a board. Let each division represent single feet or 10 ft. or 100 ft., as convenient. Then from a center *c*, at one of the principal divisions, describe a large arc, *A*, Fig. 4, and lay it off into degrees, half degrees and quarter degrees. Upon a piece of tracing vellom lay off two straight lines at right angles. The cloth should be large enough to admit of a length, *C D*, equal to the maximum stadia reading, and *D M* equal to the radius of the arc, *A*.

Now place the tracing cloth over the cross section paper, keeping *C*, the center of the arc, on the line *CM*; and, using the graduated arc *A*, make the angle $MCB = V$. Slip the cloth to the right or left along the line *CM* until $CB = R'$. Then $CE = D$ and $DE = H$, which are read off directly on the profile paper. For

$CB = R'$, and we have $R' \cos. V = CD$.

$CE = CD \cos. V = R' \cos.^2 V = D$.

Also

$$R' \sin. V = DB.$$

$$DE = DB \cos. V = R' \sin. V \cos. V = \frac{R'}{2} \sin. 2\,V = H.$$

A straight-edge and triangle may be used instead of the vellum.

For formulæ (7) and (8) the value of (*c* + *f*) must be added before using the diagram.

The degree of accuracy attainable with the stadia depends largely upon the care with which the adjustments are made, and upon the manner in which the work is done. By the Lake Survey we have understood that a discrepancy not exceeding 1 in 400 for the horizontal measurement was admitted, while an average error of only 1 in 600 was the exhibit of some of the parties.

Either is close enough for most work to which the method is adapted, and we know by experience that with reasonable care and precaution the best result (1 in 600) can be attained.

The basis of comparison is supposed to be a chained line, which is itself liable to error. We do not believe that stadia surveying is applicable where exact work is demanded, although great accuracy is often claimed for it. In very rough country it is doubtless more accurate than ordinary chaining, but it would seem best to assign it to that which should be its province, viz.: approximate surveying, including preliminary surveys and examinations and the filling in of details. For such work there is no better method, offering as it does a close approximation, secured with cheapness and rapidity.

CORRESPONDENCE.

CORRECTION.

NEW YORK, Jan. 28, 1882.

EDITOR ENGINEERING NEWS:

In the article "The Metric System for Railroads," page 28, please correct an error in the last cross-section of the *field notes*. Station 26 should be station 25 + 26; + 26 meaning the $\frac{26}{100}$ of a chain. Respectfully, J. W.

METRIC PROFILE PAPER.

NEW YORK, Jan. 27, 1882.

EDITOR ENGINEERING NEWS:

In your issue of Jan. 7, in a very interesting letter from Mr. Emile Low on the metric system on the Mexican railways, he says: "For profiles thus far the usual profile paper is being used, plate *B*, no paper ruled to metric values being obtainable."

As the New York agent for J. W. Queen & Co., I would respectfully state to those engineers interested, that in addition to their regular continuous profile paper, *A* and *B*, they have been making since March, 1881, a continoous profile paper in metric values. The divisions are, both vertical and horizontal lines, five to each half centimeter, with every fifth line heavy; every tenth-half centimeter is also indicated by an extra heavy line. This ruling makes a large square, having sides of five centimeters, sub-divided into squares of half centimeters, which are again divided by faint lines into small squares of one-fifth of a half centimeter. Respectfully,

G. S. WOOLMAN.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SO.C C. E.

Continued from page 32.

CLXXXIII.—GREENFIELD.

Greenfield, Massachusetts, in lat. 42° 30′ N., long. 78° W., is on rolling land a mile distant from and 100 ft. above the Connecticut River.

The town was settled in 1738 and incorporated in 1753. Water-works were built in 1870 by the "Fire District," after the plans of A. R. Field and under the direction of a construction committee.

The supply is taken from an impounding reservoir formed by a stone dam 60 ft. long, 85 ft. high, 16 ft. thick at bottom and 10 ft. at top, which floods an area of 4 acres and receives the drainage of 8 square miles of mountainous country.

The capacity of the reservoir is 10,000,000 gallons, and its surface is 235 ft. above the village, to which the water is conveyed 5 miles in cast-iron pipes of 8-in. and 6-in. diameter. There are 7 miles of distributing pipes of 4-in. and 3-in. diameter, with 40 fire hydrants, 21 gates, 600 taps and 2 meters. Service pipes are of galvanized iron.

The population in 1880 was 3,908, and the daily consumption 90,000 gallons.

The works cost $120,000. The receipts have been $60,000. There is a bonded debt of $60,000 bearing 5 per cent. interest. The receipts in 1880 were $5,274.51, and the expenses, exclusive of interest, $1,530.06.

The works are managed by three water commissioners, one of whom is the superintendent. This position is now held by A. A. Rankin.

CLXXXIV.—CHICOPEE.

Chicopee, Massachusetts, in lat. 42° 9′ N., long. 72° 37′ W., is on the south bank of the Chicopee River at its junction with the Connecticut River, 3 miles N. W. of Springfield. The town is on a nearly level plateau of irregular outline and the slopes which rise gradually from it to a more elevated sandy plain, the water falling on which feeds springs, the water of which was collected and carried in pipes to supply the town in 1845, after plans of Stockwell Bettes, of Springfield.

The town was settled in 1636, and was separately incorporated in 1848.

The present water-works were built in 1877 by a private company, taking the supply from an impounding reservoir on a brook north of the town, which is fed by springs issuing from the above-mentioned sandy plain. The reservoir covers 3½ acres, and contains 5,250,000 gallons, the water having an average depth of 6 ft. The dam is 150 ft. long, 12 ft. high and 8 ft. wide on top, with earth slopes of 2½ to 1 on the water side and 1½ to 1 on the lower side. In the centre is a brick wall laid in cement and resting on a bed of quicksand confined by two rows of 6-in. sheet piling driven 12 ft. below the base of the dam. The water surface is from 20 to 80 ft. above the town.

The water is conveyed from the reservoir to the distribution pipes by an 8-in. wrought-iron cement-lined pipe, 8,300 ft. long. At half a mile from the terminus of this conduit, a pipe from a pump driven by a turbine wheel is connected with the distribution, and enables direct pressure to be applied for fire purposes. A check valve prevents back-flow into the reservoir.

Distribution is by cast-iron pipe for the most part. Some vitrified stoneware pipe has been used. There are 12 miles of pipe in use, with 29 fire hydrants, 10 fire reservoirs and 675 taps. The town furnishes hydrants and pays $500 per annum for the use of the water. Lead service pipe is used.

The population in 1880 was about 7,000. The consumption is not given.

The capital stock of the company is $50,000, the works have cost altogether $61,369.36, and the gross receipts to October, 1881, were $23,645.68. The receipts in 1880 were $5,843.02, and the expenses $789.26.

W. C. McClannan is President and E. R. Stickney Clerk of the Chicopee Water Company.

CLXXXV.—FITCHBURG.

Fitchburg, Massachusetts, in lat. 42° 34′ N., long. 71° 48′ W., is on the Nashua River, in a long, narrow valley, from which the ground rises on each side to a height of 250 ft. It was incorporated as a town in 1764 and as a city in 1872.

In 1871-2, water-works were built by the city, after plans of Phineas Ball, C. E., and under the superintendence of G. Raymond and W. A. Smith, taking the supply from Scott Brook, which drains a water shed of about one square mile. The natural flow of the stream was at first taken, and in 1876-7 an impounding reservoir covering 36 acres and containing 109,000,000 gallons was formed by building an earth dam 46 ft. high, with a heart wall of rubble masonry laid in cement. Two cast-iron pipes are laid through the dam, one on the natural surface, the other 16 ft above it, resting on stone piers. The dam was raised and strengthened in 1880, increasing the reservoir capacity to 2,000,000 gallons. From the dam a 24-in circular brick conduit conveys the water 7,916 ft. to Overlook reservoir, formed by building two dams across a ravine. The upper dam, 22 ft. high and 1,000 ft. long, has no openings.

The lower dam, 42 ft. high and 400 ft. long, with a heart wall of stone 2 ft. thick, is perforated by 2 outlet pipes of 12-in. and one of 16-in. diameter. Overlook reservoir included between these dams is 400 ft. above the city, covers 13 acres and contains 60,000 gallons.

In 1879 the brick conduit between the reservoirs was found to be greatly obstructed by fine roots which had penetrated the brick-work from adjacent trees, and grown in masses from 3 to 8 in. thick.

In 1874 a 14-in. wrought-iron and cement pipe was laid from the conduit near Scott Brook to Shattuck Brook, 8,300 ft. distant, and taking the water from a drainage area of 1¼ square miles. The brook was diverted by a small dam of sheet piling covered with earth.

From Overlook reservoir the water is distributed to the higher portions of the city.

At a point in the ravine 1,150 ft. distant from the lower overlook dam another dam, 21 ft. high, forms the Marshall reservoir, covering half an acre, and containing 1,000,000 gallons at 200 ft. above the lower part of the city, which it supplies.

The pressure in the city is 80 lbs. from the low-service and 155 lbs. from the high-service reservoir. The high-service pressure can be put on the low-service system when needed.

During the drought of 1880 a pipe was laid from the reservoir to Snow's Millpond to obtain additional water.

Distribution was at first by wrought-iron and cement pipe. Since 1876 cast-iron pipe has been used for extensions.

In 1875 about 2,500 ft. of street pipes were frozen solid. Several sections of 250 ft. in length were thawed out by injecting steam and hot water.

On June 6, 1877, lightning struck the pipes in two places, entirely ruining 2,000 ft. in length. In 1878 the pipes were again struck by lightning and injured. In both instances the damaged pipe was replaced by cast-iron mains.

The total length of pipe laid to Dec. 31, 1881, was 26 miles, with 203 fire hydrants, 198 gates and 1,255 taps; 98 meters are in use.

Service-pipes are of wrought iron, cement-lined. The population in 1880 was 12,405 and the daily consumption about 1,500,000 gallons. The works have cost $439,500. Interest on $400,000 6 per cent. bonds is paid out of taxation. The revenues of the works have paid the expenses of maintenance and supplied $78,071.31 to a sinking fund. The expenses in 1880 were $5,718.15 and the receipts $15,640.53.

The works are managed by a board of commissioners. Thomas C. Lovell is the Superintendent.

CLXXXVI.—BATAVIA.

Batavia, New York, in lat. 43° N., long. 78° 48′ W., is on Tonawanda Creek in a slightly undulating country. The town was settled in 1803.

Water-works were built in 1865 for the supply of the village, for fire protection and street sprinkling, taking water from Tonawanda Creek. The village erected two Holly pumps in the mill of J. G. Cameron and laid mains and put up hydrants in the streets. The mill owner furnished water, kept the machinery in order and ran it for a stipulated sum, and has the privilege of tapping the pipes and selling water for private purposes.

In 1873 Mr. Cameron put in two La France pumps. In 1878 Olmsted & McDonald, then the proprietors, put in a Knowles pump in addition, and in 1881 erected a wooden tank holding about 22,000 gallons, on a stone foundation, 40 ft. high, in the village. This tank is an equalizer of pressure. In case of fire the tank connection is closed and water pumped directly into the mains under 100 lbs. pressure. There are about five miles of cast-iron distribution pipe from 8-in. to 5-in. diameter, with 43 fire hydrants and 250 taps. The town pays D. A. McDonald, the present mill owner, $1,000 per year for furnishing water for street sprinkling and fire extinguishing. The cost of the works is not known and the operator's expenses and outside revenue are not stated.

The population in 1880 was 7,356.

CLXXXVII.—SEDALIA.

Sedalia, Missouri, in lat. 38° N., long. 94° W., is on a high, rolling prairie. A stream draining about 250 miles of prairie land has its rise 25 miles north of the town and flows past it. The town was settled in 1860, and incorporated as a city in 1864.

In 1871, water-works were built by the city, taking the supply from the creek and pumping it directly into the mains by a gang of 6 Holly upright 12-in. pumps, with 2 rotary pumps for fire pressure, operated by a Holly steam engine.

A large spring on the bank of the creek, about two miles, supplies 200,000 gallons daily. There is now in course of construction a dam 160 ft. long across the stream, with 2 openings in it, of 40 ft. each, fitted with 9 trap gates, which are to be dropped during floods, but closed in ordinary stages, thus creating a storage reservoir of about 40,000,000 million gallons capacity.

The highest part of the city is 153 ft. above the pumps, and at that point a wooden tank 40 ft. in diameter and 20 ft. high has been erected on a trestle 40 ft. high.

The ordinary pressure at the pumps is 85 lbs., and the fire pressure is sometimes 140 lbs. per square inch.

Distribution is by cast-iron pipe of from 12 to 4-in. diameter. Eight miles are in use, with 38 fire hydrants and 575 taps. Four meters are in use, but are reported as not working satisfactorily. Wrought-iron service pipes are used.

The population in 1880 was 9,561 and the daily consumption 500,000 gallons.

The works have cost $135,000. The bonded debt is $125,000, bearing interest at 5 per cent. The interest on the debt and an annual charge of $10 for each fire hydrant are paid from a general tax. The expenses of maintenance in 1880 were $9,000 and the receipts $9,445. The Council Committee on water-works manage the works. Louis Kumm is Chairman.

CLXXXVII.—WARSAW.

Warsaw, New York, in lat. 42° 45′ N., long. 78° 10′ W., is on O-at-ka Creek at the head of the valley of the same name, between two lofty ranges of hills, 1,013 ft. above sea level.

Settled in 1803, it was incorporated as a village in 1847. Water-works were built in 1870. Water-works were built in 1870 by a private company after the plans of James O. McClure, C. E., taking the supply from 9 springs on the hill east of the village and one large spring on the west hill. Two reservoirs on the east hill contain 500,000 gallons at 265 ft. above the town. These springs have never failed entirely, but the supply at times is small. The west hill spring, which is constant, supplies a reservoir holding 250,000 gallons 360 ft. above the town. The east and west reservoirs are connected by pipes.

Distribution is by cast-iron pipe, of which 6 miles are laid of from 8-in. to 3-in. diameter, with 30 fire hydrants, 10 gates and 260 taps. The town pays $1,000 a year for the use of the fire hydrants. The population in 1880 was 3,755 and the daily consumption 20,000 gallons.

The works have cost $30,000 and the total receipts have been $17,500. There is no bonded debt. The expenses in 1880 were $150 and the receipts $2,200. The capital stock of the company is $25,000. W. J. Humphrey is President; B. F. Fargo, Secretary and Treasurer, and J. O. McClure the Engineer.

CLXXXIX.—URBANA.

Urbana, Ohio, in lat. 42° 2′ N., long. 84° 53′ W., is in a rolling country, well supplied with springs. A small stream, fed by a spring, flows through the town, which is on nearly level ground, with a gravel subsoil, containing water at from 10 to 30 ft. below the surface.

Settled in 1792, it was incorporated as a city in 1867. In 1878 water-works were built for a private company by the Holly Manufacturing Co., taking the supply from a well 20 ft. in diameter and 15 ft. deep, and pumping directly into the mains by a Holly four-cylinder engine of 1½ million gallons' capacity, working under an ordinary pressure of 40 lbs. per square inch and a fire pressure of 100 lbs. Distribution is by cast-iron pipe, of which 9 miles are in use, of from 14 to 4-in. diameter, with 74 fire hydrants and 320 taps and 2 meters. Lead service pipe is used. The city pays $100 per year for each of 60 hydrants and $75 for each one over that number.

The population in 1880 was 6,252 and the daily consumption 250,000 gallons.

The capital stock of the company is $100,000 and the bonded debt $65,000, bearing 6 per cent. The works have cost $85,000. The expenses in 1880 were $3,400 and the receipts $10,050.

J. H. Ayers, M. D., is the Treasurer and Superintendent of the company.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks: From Louis Kumm, Chairman Committee on Water-works, statistics of the water-works of Sedalia, Mo. From Robert Surtees, City Engineer, report of water-works of Ottawa, Canada, December, 1881. From N. I. Jordan, Treasurer Water Company, statistics and water rates of the water-works of Auburn, Me. From Charles E. Fowler, City Engineer, contract between Water Company and City of New Haven, Dec. 15, 1881. From D. Hammond, Superintendent, statistics and water rates of the water-works of Emporia, Kan. From John M. Steele, Superintendent, statistics of water-works of Bordentown, N. J. From W. H. Johnson, Secretary, statistics and water rates of the water-works of Alpena, Mich., and laws under which the Water Company is organized. From A. W. Berry, Superintendent, statistics and water rates of the water-works of Gloversville, N. Y., and reports for years ending April 30, 1880 and 1881. From J. H. Ayers, M. D., Superintendent and Treasurer, statistics and water rates of the water-works of Urbana, O. From E. Metsch, Clerk and Superintendent, statistics of water-works of East Liverpool, O. From T. N. Boutelle, Superintendent, a description of the water-works, Fort Dodge, Iowa.

NO FLAGMAN WAS SENT BACK.—ROCHESTER, N. Y., Jan. 24.—This morning an east bound freight train on the New York Central Railway became stalled two miles east of Clyde, and a few minutes later the train following ran into it, smashing the caboose and setting fire to it. The flames were extinguished before the fire communicated to the other cars, and then it was discovered that Conductor John McManus, of the stalled train, was in the caboose and burned to death. The loss of property is inconsiderable, and the tracks were clear in an hour. It seems that no flagman went back from the stalled train.

Google

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.
Tribune Building, New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR........................ASSOCIATE EDITOR.

SATURDAY, FEB. 4, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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SPUYTEN DUYVIL CATASTROPHE.

In last week's issue of ENGINEERING NEWS we published the verdict of the Coroner's jury in the case of the Spuyten Duyvil catastrophe, and at the same time republished opinions from the local press commenting upon the character of this verdict, a course which we have not hitherto pursued in such cases, but which we thought was called for, as exhibiting so fully the tendency of the framers, as well as the exponents of popular opinion, to diversity of sentiment, even upon matters which would appear to admit of but small differences of opinion, whether, as in the present case, we consider the simplicity and the concurrence of the evidence submitted to the jury, their sworn duty in the premises, or the great importance to obvious public interests, that "their trumpet should make no uncertain sound," and that no scapegoat should be found upon whom to visit the dereliction of duty on the part of any man or set of men who trifle with the lives of the traveling public. There has been too much of this disposition shown heretofore on the part of coroners' juries to evade their responsibilities and regard as *accidental*, and so beyond the control of man, what, in some cases, and notably in the present one, would have been miraculous had it not happened; and that the jury should have rendered, what the world characterizes as "so sweeping a verdict," in the very face of the Railroad King is an evidence of moral courage which should command the support of all, and which we most heartily approve.

Discussions upon the management of railroads have formed no part of our editorial labors. This field has been filled, and ably filled, by our valued contemporary, the *Railroad Gazette*, and to which we have been accustomed to look for practical and sound opinions upon all matters touching the management of roads, which in the present day is no longer regarded as a branch of engineering. It has reached us, however, that our failure to comment upon this late evidence of mismanagement is misunderstood, and we are, therefore, constrained to depart so far from the path which we had marked out for ourselves as to comment upon coroners' verdicts, and "give a reason for the faith which is in us," premising that while we make no claim to being "experts" in railroad management, yet we are not without experience in such matters, acquired in the days when the charge of railroads by their engineers did not cease on the completion of the work of construction. It is true, that the great complications growing out of various and diverse interests to be reconciled in order to the successful working of the railroad system of to-day, did not then exist, and the "bulls" and the "bears" were not permitted to thrust hoof or paw into affairs presumed to be beyond their capacity, but the principles and practices then found essential to successful operation are no whit less important now than then, being based upon the immutable laws of nature—and we may add—common sense.

As we understand the duty of a coroner's jury, and as expressed by one of the dailies, which was not in accord with the verdict rendered, it is to determine "where the responsibility rests for the loss of life."

The only feature in the case which will bear the characterization of "accident" was in the operation of releasing the air-brakes. This was performed by some one as a stupid joke. It does not appear in the evidence who this was, but it matters little, as in itself it was a small matter, not necessarily attended with any risk of what is called an "accident."

The train being stopped, the first duty of the conductor is to dispatch a brakeman with a signal, in each direction ordinarily, but in the present case, as it was known that a local train was following the express, the *first* duty of the conductor was to flag this train; the conductor failed to do this, or rather failed to see that it was done, and so became responsible for what happened. The rear brakeman knew that it was in the line of his duty to flag the coming train; had he performed his duty in this respect no loss of life would have occurred. This failure of duty on his part rendered him equally responsible with the conductor for what followed. The enginemen of the Chicago express, aware of the fact that the air-brake had been sprung, and it proving no part of their duty to investigate as to who had sprung the brakes, violated their known duty in attempting to move the train, and succeeding in moving the train to a point of absolute danger in reference to the field of observation from a following train became equally responsible with the conductor and brakemen for what subsequently happened. The engineman of the following train (Tarrytown local) aware by his time that there was a train in advance of him, and also aware of the principle that in approaching a dangerous point of the road he was not to rely wholly upon others to apprise him of danger, but should himself be keenly alive to the possibility of danger in his front, failed to exercise the proper degree of watchfulness, and rendered himself equally responsible with the conductor, brakeman and engineman of the express for what followed from his neglect. There are few places on the railroads leading out of New York where the element of *possible* danger, through neglect of employés to faithfully perform their duty, is more apparent than at this locality; and this *possibility* of danger should have been impressed upon the operatives of the road in the instructions from the Superintendent, calling their especial attention to the proper precautionary measures to be observed in passing it. The failure of the Superintendent in appreciating, or in causing his employés to appreciate, the fact that this was to be regarded as a point of danger, renders him responsible with them for what followed from their neglect or ignorance.

And finally, the economy which forbids the employment of a local flagman for this point of danger, and in the failure to supply obviously needed implements for such a catastrophe, as similar occurrences in our country have shown to be essential to save life, renders the managing head of this great road equally responsible with his employés. That this is so is evident if we consider that the concurrent action, or non-action, as the case may be of the *entire five* operatives, together with the defects in the regulations and the parsimony of the *owner*, was essential to bringing about that condition of things which resulted in *loss of life*. The mere stoppage of the train (a constant occurrence on railroads,) was not in itself a cause for the disaster which followed, but merely the *occasion*, through which the shortcomings of the agents of the road all conspired to bring about the fatal result.

We regard the verdict of the Coroner's Jury as eminently proper, and if the action of the Grand Jury should fail to confirm it, it will be more to be deplored than was the "accident" itself. [As we go to press we understand the action of the Grand Jury to be an indictment of the conductor and brakeman of the express "for negligence in the performance of their duty;" with a gentle reminder to the railroad company that it would be well if the trains carried certain tools, etc.

We have but a single remark to make to this:

Would the negligence of these two men alone have sufficed to insure a loss of life had the remaining individuals implicated by the Coroner's verdict performed their entire duty in the premises?]

COLORADO INSTITUTE OF ENGINEERS.

This new professional association has just been formed at Leadville, Col., and we have been favored with a series of circulars from the Committee on Organization. These circulars are for the instruction of candidates for membership, and are almost *verbatim* reprints from similar ones of the American Society of Civil Engineers. The membership is divided into resident and non-resident members and associates: the fees are for entrance $20, $15, $12 and $8 respectively, and quarterly dues are $6 and $1.50, the total being only a dollar or so less than for the New York Society. The new Association has apparently resolved to spend no time in discussing constitutions and by-laws, but presuming on the perfection of that of the A. S. C. E., adopts it bodily. Living in high altitudes, we judge from the aspirations of this latest fledgling, begets equally altitudinous ideas, and we are pleased to see that there is "nothing mean" about the new "Institute" in the way of asking a good price for admission to its sacred circle. The committee are Fred. G. Buckley, Thos. W. Jaycox and Chas. J. Moore, the two latter gentlemen being personally well known to us as enthusiastic and capable engineers, whom we trust will succeed in effecting a large and influential professional organization from among the many well qualified engineers in the far West. We think, however, they have made a mistake in modeling their organization after that of the A. S. C. E. instead of that of the American Institute of Mining Engineers. The committee's circular closes with stating that they believe engineers will "find profit in a membership"; we will await the advent of the Proceedings and Transactions of the new "Institute" to prove the faith that is in its promoters.

A DISASTROUS FIRE.

As we looked up casually from our work on Tuesday morning last the violent gesticulations of a rapidly-gathering crowd in the street just below drew our attention and another glance revealed a broad column of flame issuing from the old *World* newspaper building directly in front. Hastening to the street we were in time to witness the fearful leap of a woman from the top story to the hard pavement below, to meet death in another form than by fire, and to witness the heroic and successful feats performed in the saving of life by the fire department and citizens. For a time, during which moments seemed hours, one's heart seemed to cease beating while witnessing the fearful scramble for life by the flame-pursued occupants of the wretched trap that was burning, and only when the flames bursting from every opening cut off further efforts to save life could we realize the fierce contest that was in progress. Never before did we so realize the value of a minute of time as when witnessing the slow raising of a ladder to find it only too short to reach the point at which the fire-beleaguered supplicant awaited its coming as the only hope of life. The daily papers have spread far and wide every particular of this most disastrous fire; and but for its close proximity to our own quarters we would hardly have referred to it. The scenes transpiring before our windows since Tuesday must be seen to be appreciated, and while we write (Friday noon) a steamer is still puffing away at the mild-faced Ben Franklin, who scarcely could have dreamed of such sights as he has so imperturbably witnessed from his pedestal nearly all the week. Where was the busiest hive of newspaper workers in the city at the opening of the week, now only remains a huge pile of smoking débris, from which burnt safes are being hauled and around which a crowd is gathered in expectancy of seeing the possible remains of the burned victims exhumed. We can but record our opinion that the existence of such fire-traps is disgraceful to modern civilization, but we hardly expect to see much improvement so long as a ready market at enormous prices can be found for every foot of renting space. The efficiency of the modern fire department is never realized except on such an occasion, and its coolness, energy, fearlessness and promptness were never better exhibited than on this appalling occasion. The value of fire-proof walls and well-constructed buildings was well illustrated by the successful resistance of the *Times* partition to the progress of the fire. Had this end of the building been the same in character as the other end there is no knowing where the finish would have been, and it probably would not have been our good fortune to be addressing our readers from our present comfortable quarters, even though they be considered fire-proof. Concerning our esteemed contemporary, we beg leave to inform our readers that Messrs. Munn & Co., publishers of the *Scientific American* and *Scientific American Supplement*, occupied offices in the burned building. The subscription books and list were protected by a safe and found to be in good condition. The two papers will be sent as usual, and as soon as possible extra numbers will be printed of the *Scientific American* for the past eight or nine years, and of the *Supplement* since its commencement, the plates having been kept in another building. All orders for back numbers will be filed and filled as soon as possible. The offices now occupied by the paper are at 261 Broadway.

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PERSONAL.

Ralph R. Osgood, of Troy, N. Y., manufacturer of "boom dredges," steam excavators, etc., on Jan. 9, formed a copartnership with **James MacNaughton**, under the firm name of **Osgood & MacNaughton**. The offices of the firm are at 37 State street, Albany, N. Y.

B. R. Morton has been unanimously re-elected City Engineer of Newport, O.

The Late Col. E. S. Purdy.—The Academy announces the death at Cairo of Col. E. S. Purdy, Pasha of the Egyptian general staff. Col. Purdy was born in the State of New York, and received his scientific training at West Point. At an early age he served under Gen. Stone on the cadastral survey of Sonora and Lower California, and afterward saw service in the war with the Southern States. For several years past he has been one of the most prominent of the American officers under General Stone Pasha, chief of the Egyptian general staff, and has been long engaged in survey work in Upper Egypt. He served with Ismail Eyub Pasha in the Darfur expedition and took a leading part in laying down the map of that province. As lately as May 14 Colonel Purdy exhibited his large map of Darfur at a meeting of the Cairo Geographical Survey, and read a paper on his journey to Dara and Hotra-el-Nahas, giving an account of the inhabitants and resources of Darfur, its fauna and flora, hydrography, etc. Colonel Purdy was only forty-two years of age at the time of his death.—*London Times.*

M. S. Lincoln, Chief Engineer of the Wabash, St. Louis & Pacific Railroad will have charge of the Bridge and Building departments, including bridges and all structures.

Massachusetts Institute of Technology.—The Society of Mechanical Engineers of this Institute this week visited some of the great manufacturing establishments of Western Massachusetts and Connecticut, accompanied by Professor Channing Whittaker and his assistant, Mr. William H. Beeching.

A. M. Wellington has resigned the position of Principal Assistant Engineer of the Mexican National Railways to accept that of Assistant General Manager Mexican Central Railway, with headquarters at 5 San Fernando, Mexico.

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OBITUARY.

Alexander Lyman Holley, of world-wide celebrity as a metallurgical and mechanical engineer, died at his residence in Brooklyn on Sunday evening, the 30th ult. He had visited Europe in hopes of finding relief from bodily ailments, but unsuccessfully, and was advised by his medical advisers to return home. His wife and two daughters, comprising his entire family, followed as soon as they could leave Europe and arrived in the Germanic on Sunday but not in time to reach his bedside before death came.

Mr. **Holley** was born in Lakeville, Conn., in the year 1832, where his father, ex-Gov. A. H. Holley, still resides. He graduated in 1853 from Brown University, and soon afterward entered the Corliss Steam Engine Works. His technical studies were supplemented by a year's practice as a locomotive engineer on the Stonington Railroad. He next worked for a considerable period in a locomotive works in Jersey City. During the period from 1855 to 1860 Mr. Holley published several important works, among the most notable of which were a treatise on "Railway Economy" and "Reports on European Railways." He was assisted in the last-named work by the late Zerah Colburn. At one time Mr. Holley, under the *nom de plume* of "Tubal Cain," contributed a series of letters to the *New York Times*. He crossed to England on the steamship Great Eastern on her first transatlantic voyage, and, becoming acquainted with Brunel and Scott Russell, he thoroughly studied the structure and sea-going qualities of the vessel. He subsequently made the acquaintance of the late Edwin Stevens, of Hoboken, and was engaged as consulting engineer in the construction of the Stevens battery. This work led him to visit England a second time, in 1862, for the purpose of studying the latest improvements in offensive and defensive warfare. The result of his studies was the publication, in 1864, of a treatise on "Ordnance and Armor," which has since been recognized as the standard authority. Through the efforts of Mr. Holley the patents in the United States for the Bessemer process of manufacturing steel were secured in 1864 for an association in this country, and in 1865 the first Bessemer works in the United States were built under his supervision in Troy, N. Y. From that time until his death Mr. Holley continued to be the foremost American expert in that line. The extraordinary progress which the American works have made in this art over those of other countries is conceded to the skill and practical inventive genius of Mr. Holley.

From a paper on "The History of the Bessemer Manufacture in America," read before the American Institute of Mining Engineers at its meeting in Philadelphia, June, 1876, we extract the following: "His mechanical intuition was alive to the possibilities of improvement of the Bessemer process and the result of his thought gave us the present accepted type of American Bessemer plant. He did away with the English deep pit and raised the vessels so as to get working space under them; he substituted top-supported hydraulic cranes for the more expensive counter-weighted English ones, and put three ingot cranes around the pit instead of two, and thereby obtained greater area of power. He changed the location of the vessels as related to the pit and melting-house. He modified the ladle crane, and worked all the cranes and the vessels from a single point; he substituted cupolas for reverberatory furnaces, and last, introduced the intermediate or accumulating ladle which is placed on scales, and thus insures accuracy of operation by rendering possible the weighing of each charge of melted iron before pouring it into the converter. These points cover the radical features of his innovations. After building such a plant, he began to meet the difficulties of details in manufacture, among the most serious of which was the short duration of the vessel bottoms, and the time required to cool the vessels to a point at which it was possible for workmen to enter and make new bottoms. After many experiments he introduced the Holley vessel bottom, which has rendered possible, as much as any other one thing, the present immense production. His subsequent invention of the removable lining for the converter, adapted the basic process to American practice. Considering the vast improvements brought about by Mr. Holley's untiring efforts, we cannot but pay a high tribute to his enterprise and activity."

At the time of his death Mr. Holley was receiving a large salary as consulting engineer of the Associated Bessemer Steel Manufacturers in the United States, and having already acquired considerable property, he left his family in comfortable circumstances. Three great societies—the American Society of Civil Engineers, the Institute of Mining Engineers, and the Institute of Mechanical Engineers—have distinguished him with official honors. He was made President of the Institute of Mining Engineers in 1875, and was one of the founders and most enthusiastic supporters of the Institute of Mechanical Engineers. In his numerous papers and addresses before these societies he displayed a high order of literary ability, as well as professional skill and acumen. He was an excellent after-dinner speaker, and of a genial and humorous disposition. He was fond of art, and was a friend of most of the leading artists in this country.

At the May meeting of the Institute of Mining Engineers, held in Pittsburgh in 1879, Mr. Holley was presented with a beautiful gift in silver by his friends and associates in the Bessemer steel interest, as a recognition of his invaluable professional services. His response to Mr. W. P. Shinn's address of presentation will never be forgotten by those who heard it, and few heard it without tears. It concluded as follows: "Among us all who are working hard in our noble profession and keeping the fires of metallurgy aglow, such occasions as this should also kindle a flame of good fellowship and affection which will burn to the end. Burn to the end—perhaps some of us should think of that, who are burning the candle at both ends. Ah! well, may it so happen to us that when at last this vital spark is oxidized, when this combustible has put on incombustion, when this living fire flutters thin and pale at the lips, some kindly hand may turn us down, not underblown—by all means not overblown—some loving hand may turn us down, that we may perhaps be cast in a better mold."

The funeral took place on Wednesday from Plymouth Church, Brooklyn. Rev. Henry Ward Beecher delivered a brief but eloquent address, and large delegations of prominent members of the American Society of Civil Engineers, and the American Institute of Mining Engineers were present, the pall-bearers also being leading men in these associations.

Those only who knew Mr. Holley best can appreciate how severely his loss will be felt.

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SEWERAGE OF EUROPEAN CITIES.

From Mr. Rudolph Hering's report, made to the National Board of Health, noticed in Engineering News for last week, we promised some abstracts of statistics from the various cities which were embraced in the field of his observations—and commence with

LONDON.

Population.—Drainage and water-supply district, 4,848,400. Average density, 55.6; varies from 42 to 174 per acre.

Area of Metropolis.—122 square miles = 78,080 acres. Greatest length, 14 miles; greatest width, 8 miles.

Number of Dwellings.—In drainage district, 585,000. Number of inhabitants per house, average, 7.4.

Water Supply.—From rivers Lea, Thames and chalk wells, per day, 145,800,000 gallons; from chalk wells, per day, 9,140,000 gallons; from river Lea, per day, 61,989,000 gallons; from river Thames, per day, 74,614,000 gallons; 145,743,000.

Eighty-one per cent. used for dwellings; 19 per cent. for streets, fountains, etc. Average, 32.7 gallons per head. All river water is filtered.

Mortality. — 1840–1849, 25.1; 1850–1859, 24.1; 1860–1869, 24.3; 1870–1879, 23.0.

Meteorological.—Temperature: Thirty years mean annual, 49.4 Fahrenheit; mean monthly maximum, 72.8 Fahrenheit; mean monthly maximum, 82.7 Fahrenheit; maximum seldom above 80 deg., though it has reached 94 deg.; minimum seldom below 15 deg., though it has reached —5 deg.; mean daily range, 16.9; mean monthly range, 36.8 Fahrenheit; frost penetrates soil to a maximum of 2 ft.; rain, annual, from 18 in. to 30 in.; thirty years mean, 24.4 in.; number of rainy days per year, 170; mean humidity, 81. Rain storms, maximum:

	Inches per minute.
1846, August, 3.3 in. fell in 140 minutes; 2 in. in 30 minutes	.067
1852, July, 0.5 in. in 15 minutes	.033
1857, October, 2.92 in. in 36 hours	.0013
1874, May, 0.34 in. in 8 minutes	.043
1874, June, 0.96 in. in 30 minutes	.032
1874, July, 2.23 in. in 84 minutes	.027
1878, June 23, 3 in. (nearly) in 90 minutes	.033
1878, April 10 and 11, 2.64 in. in 19 hours; maximum in 90 minutes.	
1880, July 14, 0.36 in. in 12 minutes	.030

Topographical.—Situate on both banks of the Thames 40 miles above its mouth. Largest area is on the northern bank, where the surface is above floods. Southern bank is low, with districts below ordinary high water, gradually extending to high and hilly grounds near the southern boundary. Average tide in Thames, 18 feet. At Barking and Crossness outfalls mean low water is —7.6; mean high water is +10.72.

Extreme tides:

1874, March 20	high water + 16.50
1874, April 18	high water + 16.00
1874, Oct. 21	low water — 10.00
1875, Nov. 15	high water + 16.83
1877, Jan. 2	high water + 16.60
1877, Jan. 31	high water + 16.00
1877, Oct. 8	high water + 16.00

Physical.—Greater part of metropolis is closely built up, especially older portions of the center, north, and south of river. West and northwest contain many open areas, parks and gardens. Total length of streets is 2,600 miles, of which 1,338 miles are paved with macadam and partially granite blocks, 274 miles entirely with granite blocks, 23 miles with asphalt, and 15 miles with wooden blocks.

MANAGEMENT OF PUBLIC WORKS.

They are in charge of a Metropolitan Board of Works, an elected body of 45 members, each serving three years. The metropolis is divided into vestries, larger ones sending one representative and some two, smaller ones combining into districts with one representative. The board is thus formed of representatives from 24 vestries and 15 districts. A chairman is elected from their number. Their duties consist in supervising all main public works, among which is the main drainage system in design, construction and maintenance. The Board levies rates and borrows money for its purpose. All main sewers are both designed and built by the Board. Ordinary sewers in each vestry and district are built by district boards, which have each an engineer and surveyor, with necessary corps of assistants. But all their plans must previously be submitted to the Metropolitan Board for approval. Permanent staff of Metropolitan Board of Public Works, engineer's department: Main office, 1 engineer-in-chief, 2 assistants to chief, 1 principal clerk, 16 engineers and draughtsmen. Flushing staff, 5 inspectors, 8 clerks, 18 gaugers, 107 flushers, 36 sluice and flap keepers, mechanics and laborers. Pumping stations and outfall, 4 superintendents, 126 mechanics and laborers.

DESIGN AND CONSTRUCTION OF SEWERAGE WORKS.

1. *General System and Alignment.*—Combined water-carriage with interception of sewage and slight portion of rain, at several levels, discharging it 10 miles below city into the Thames at outgoing tides. The valley line sewers, mostly old, receive excess of storm-water either direct or from overflows, and discharge by shortest line to the river. The Thames divides the system into two independent parts.

In the north there are three main intercepting sewers: The high, mid and low level, and a few lateral branches, with final outfall at Barking. The high-level sewer begins south of Highgate, extends eastwardly to the valley of Heckney Brook, and crosses Victoria Park to Old Ford. The mid level begins near Harrow Road, passes under Paddington Canal, follows Uxbridge Road, Oxford street, Old street, Victoria Park and joins the high level at Old Ford. These two sewers intersect all sewage that can flow into the Thames by gravity. A branch from the elevated grounds at Piccadilly joins the mid level. From Old Ford to Barking, the two sewers are united in one embankment, built for them on account of the low grounds, and form the northern outfall sewer. At Barking a reservoir of 9½ acres, and 6,700,000 cubic feet capacity, collects and holds all the sewage during incoming tides. The low level sewer runs under the Thames embankment to Blackfriars, thence to Tower Hill and Abbey Mills, where its contents are raised 36 ft. by steam-power, and discharged into the outfall sewer just mentioned. Several branches are connected with the low-level sewer. South of the Thames there is a high-level and a low-level intercepting sewer, with final outfall at Crossness. The high-level is formed of branches skirting the higher grounds and uniting at Deptford, and then continues its course to Crossness at the southern outfall sewer, where the sewage is raised 10 to 30 ft. high into a reservoir, from which it is discharged during outgoing tides. The low-level sewers, one beginning at Putney and the other at Bermondsey, unite at Deptford, where their sewage is pumped 18 ft. into the outfall sewer just mentioned. When crossing these intercepting sewers, the old valley-line sewers are connected with them to take the storm-water overflow and lead it directly into the river. At present several extensive overflow-sewers are being built in addition in various sections. The daily amount of sewage intercepted by the main drainage works is about 10,000,000 cubic ft. north and about 4,000,000 cubic ft. south of the Thames. The united capacity is 63,000,000 cubic ft., including a rainfall of ¼ in. in 24 hours. The system was designed by Sir J. W. Bazalgette.

Shape and Size of Sewers.—London exhibits a greater variety of shape in its sewers than any other city, representing as it does the ideas of several centuries. At present the following forms are used: Circular, for pipe sewers which rarely exceed 18 in. diameter, and for certain intercepting sewers. The egg-shape is common for all brick and concrete sewers, except those for interception and storm-water. The oval form, having a larger invert radius, is used when a comparatively great ordinary flow is to be removed. Other forms, such as flat or slightly curved inverts, or railway tunnel sections, etc., are used for special purposes. For formula used for dimensions see ENGINEERING NEWS, Jan. 28, page 34.

The amount of sewage calculated is one half of daily amount, assumed at 34 gallons per head, therefore 17 gallons, to flow off in 6 hours.

The smallest sewers used are 9 in. pipes, but generally not less than 12 in. in diameter. The smallest brick or concrete sewers are 2 ft. by 1 ft. 3 in. In the City of London the ordinary sewers are usually of brick, 4 ft. 6 in. by 3 ft. and 4 ft. by 2 ft. 6 in. with a terra-cotta invert block of 10 and 12 in. radius. The northern high-level sewer ranges from 4 ft. diameter to 9 ft. 6 in. by 12 ft.; the mid-level from 4 ft. 6 in. by 3 ft. to 12 ft. by 9 ft. 6 in.; the low-level from 6 ft. 9 in. diameter to 10 ft. 3 in. diameter. The southern high-level sewer ranges from 4 ft. 6 in. diameter to 10 ft. 6 in. diameter. The northern outfall has 3 sewers, each 9 ft. by 9 ft., side by side. The southern outfall is 11½ ft. diameter.

Depth and Grades.—The depth of ordinary sewers below the street surface is from 12 to 15 ft. Cellars and basements are from 5 to 10 ft. deep; and if deeper, sewage must be raised into the sewer by the private parties. When a sewer for purpose of grade is over 16 ft. deep, a second one is built above it to receive house connections. Grades for sewers are usually limited to give a minimum velocity of 18 in. per second. Grades of

Northern high level	1 : 71, then 1 : 376, finally 1 : 1100
Northern mid level	1 : 300 to 1 : 2640
Northern low level	1 : 1700 to 1 : 2640
Northern outfall, 1:2640 (invert at outlet is 18 in. below high water).	
Southern high level	1 : 176 to 1 : 2266
Southern mid level	1 : 100 to 1 : 2:66
Southern low level	1 : 1320 to 1 : 2640
Southern outfall	1 : 2640

Junctions, Overflows, Outfalls.—Junctions of sewers are generally made by easy curves, but there is no uniformity in the details. They are generally covered by a funnel arch, and have a tongue between the sewers. The chamber has a ventilator to the surface. Overflows vary in design, and are generally placed at three-fourths of height of sewer. The mouth is wide, to take the water freely, and is then reduced to a circular or egg-shaped channel. Outfalls of main drainage sewers are at Crossness and Barking. At the latter sewage discharges by gravity. It is stored in covered reservoirs of 9½ acres, and discharged only during outgoing tides. At Crossness the sewage is pumped into reservoirs of 6½ acres, from which it is discharged also during outgoing tides.

Ventilation.—Sewers are ventilated by frequent openings into the streets, generally by special shafts 6 in., 8 in., 10 in., or 12 in. in diameter, terminating in the side of a basin, which is covered by an open grating. Man-holes are also often ventilating. Formerly the furnaces and stacks at pumping-stations were made use of for ventilation, but this is now abandoned, as it checks the draft, and is not efficient except for a short length of sewer.

Man and Flushing Shafts.—Man-holes are mostly built with side entrances, especially in the central portion of the metropolis, having either vertical shafts or steps. When in the street they are circular, and usually 2½ to 3 ft. in diameter, covered with a grating, partially open and partially with inserted blocks of wood to deaden the noise of passing wheels. When ventilation is required, a small basin to catch the street dirt is placed beside the shaft of the man or lamp-hole, and through this the air passes out. It is about 9 by 18 in., and is covered by an open grate, while the man-hole cover has no openings. Special shafts for flushing are sometimes placed at the upper ends of the pipe-sewers.

Gullies.—The gullies are commonly placed under the gutter, the inlet being covered by a grating 16 by 18 in. hinged. They are generally 4 ft. deep and have almost always a catch-pit and a trap. The pipe leading to the sewer is 6-in. or 9-in. diameter. The trap is formed sometimes by a flag-stone 3 in. thick, let down from the top and sometimes by the outlet pipe itself. The seal is about 12 in. They are not located at the street corners, but in the blocks, generally 200 or 300 ft. apart. Some inlet-basins are of iron 33 by 21 in. and 3 ft. below the grating. There are a few inlets which lead directly into the sewer without trap or basin, by 9-in. terra-cotta pipes.

Pumping-Stations.—London has four large pumping-stations. They are at Deptford and Crossness, on the southern side, and at Pimlico and Abbey Mills, on the northern side of the Thames. The Deptford station is the oldest, having been in use 17 years. The sewage is raised 18 ft. from the southern low-level sewer into the outfall. The inlet is a twin sewer, each 7 ft. in diameter. The ordinary depth of water in them is 4 ft. There are 4 engines, each 125 horse-power. Amount of sewage which can be raised is 18,728 cu. ft. per minute. The Crossness station is situated at the southern outfall. The sewage is raised from 10 to 30 ft. either directly into the Thames or into storage reservoirs, of which there are 4, each holding 6,000,000 gallons, and covering together 6¾ acres. The tide runs out 7 hours. Gates are left open 1 hour before to 4 hours after high tide. There are 4 engines, each 125 horse-power, driving 32 pumps and lifting ordinarily 106,400 gallons per minute. Diameter of pumps, 4½ ft. Four have a stroke of 4 ft. and 4 have a stroke of 2 ft. The works are being extended. Amount of sewage which can be raised per minute is 17,028 cu. ft. The Abbey Mills station is situated on the line of the northern high level, where the sewage from the northern low level is pumped into it 36 ft. high. The diameter of the inlet sewer is 10 ft. 3 in. There are 8 engines, each 142 horse-power, driving 16 double-acting pumps, raising ordinarily 96,000 gallons per minute. The amount of sewage which can be raised per minute is 15,000 cu. ft. The western pumping-station (Pimlico) is the most recently built. Here the sewage from west of Chelsea is raised into the northern low-level sewer. The inlet is 6 ft. 9 in. in diameter with an ordinary depth of sewage of 3 ft. The lift is 17.8 ft. (— 19 to — 1.20 below datum). During heavy storms the sewage is pumped into the Thames. There are 4 engines, each 90 horse-power, with a supplementary engine, 120 horse-power. The engines drive 2 pumps, each of 5 ft. 3½-in. diameter and 4-ft. stroke. Six thousand cubic feet of sewage can be raised per minute. In 1878 the engines at work, representing 2,620 nominal horse-power, consumed about 23,340 tons of coal.

Materials and Construction.—Materials used for sewers are brick, concrete and terra-cotta pipe. Concrete is preferred where not too expensive. Portland cement is used for it in proportions of 1:4 to 6 of Thames ballast (gravel and sand mixed), and allowed to set one week before centers of large sewers (6×4 ft.) are drawn. Concrete sewers many years old presented a perfect condition, with very little adhesion of sewage particles and very little odor.

Before 1846 no sewers were egg-shaped, none were built of vitrified pipe, and none of half bricks.

Statistics.—Ludgate Hill sewer was built before the year 1668; Fleet street sewer was built in 1668; first surveyor for London was appointed in 1768.

Length of sewers:		Miles.
Up to 1855 inclusive		1,146
Up to 1856-1877 inclusive:		
Main drainage	82	
District sewers	857	
Reconstructed sewers	56	
		995
1878 to 1880 inclusive		135
Total length of sewers		2,276

Of which 550 miles are of vitrified pipe.

Intercepting sewers:	
Northern high level, length, miles	7¼
Area drained, square miles	10
Northern midlevel, length, miles	9¼
Picadilly branch, miles	2¾
Area drained, square miles	17¾
Northern low level, miles	8¼
Hackney branch, length, miles	2¼
Isle of Dogs branch, length, miles	1¾
Area drained, square miles	11
Western extremity of northern low level, length, miles	5¼
Fulham branch, length, miles	1¾
Acton branch, length, miles	1¾
Area drained, square miles	12¾
Northern outfall sewer, length, miles	3¾
Southern high level, length, miles	5¾
Effra branches, length, miles	7¾
Area drained, square miles	20
Southern low level, length, miles	9¼
Bermondsey branch, length, miles	2¾
Greenwich and Deptford, length, miles	1¾
Area drained, square miles	20
Southern outfall sewer, miles	7¼
Area drained, additional, square miles	2

Daily amount of sewage discharged into Thames from both outfalls, 17,600,000 cu. ft. Deptford pumping station was opened ———, 1864. Crossness-pumping station was opened April 4, 1865. Abbey Mills-pumping station was opened July 30, 1868. Western (Pimlico) pumping-station was opened Aug. 5, 1875. Number of gullies in 1878 was 67,491.

Disposal of Sewage.—The metropolitan sewage is discharged into the Thames at Barking and Crossness, 10 miles below the city. It is temporarily stored in reservoirs during incoming tides. Velocity of water in Thames, average 4½ inches per second.

	RESERVOIRS.		DISCHARGE.	
	Area.	Capacity.	Daily sewage.	Maximum rainfall.
	Acres.	Gals.	Cu. ft.	Cu. ft.
Barking	9½	45,000,000	11,000,000	28,500,000
Crossness	6¾	24,000,000	6,000,000	17,200,000

MAINTENANCE OF SEWERAGE WORKS.

Appliances.—Sewers are cleaned generally by flushing. Old sewers with flat inverts, and new ones when accidental obstructions occur, are entered and cleaned with scrapers and shovels. Pipe-sewers, when they become obstructed, are cleaned with circular brushes drawn through them, or by jointed hooks, which are closed when pushed in, and are forced open by a spring when drawn back. For flushing the pipe-sewers, either flap-valves are used or such as work in a groove, regulated from above to dam the sewage or flushing water. Large sewers have penstocks inserted at necessary intervals. They are generally worked from above, and consist of a heavy door either drawn upward or swinging to one side. The pumping-stations also have penstocks to hold the sewage back temporarily or to regulate the discharge into the river or to the pumps.

The gullies are cleaned regularly and often. The scoops used have a flat or semicircular bottom.

SEWAGE OF LONDON.

In 1878 there were taken out of sewers 723 cubic yards of deposits.

In 1878 there was taken out of street basins 100,050 cubic yards silt.

COST OF SEWERAGE WORK.

Management and Maintenance.—Total cost of maintaining sewerage work under Metropolitan Board, $392,000. The maintenance of all the London sewers cost about 25 cents per head per annum, including pumping, which is about 8 cents per head.

Construction.—Total expended for intercepting and main sewers since consolidation has been $27,500,000. This includes 82 miles of main intercepting drainage and 58 miles of main valley line sewers, making 140 miles. Average cost of main drainage per mile is $280,000; of the main valley line sewers per mile, $65,000.

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SAFE AND UNSAFE BRIDGES.

On the 26th ult., before the Society of Arts, Boston, Prof. Geo. L. Vose spoke of the defects in the present method of building and inspecting railroad and highway bridges in the United States. He said that in the year 1881 there were 43 bridge accidents, and that during the nine years ending with 1881 their number had been 216, an average of 24 per year, not one of which could not have been foreseen by a proper inspection, and prevented. From 1874, when there was 33, there was a steady decrease in the record to 16 in 1880; but the large number of last year has dispelled the hope that a better condition of things was being brought about. In fact, hundreds of bridges on constantly traveled ways are quite as weak as those that have fallen and need but the same combination of circumstances to meet the same fate. Until public opinion demands it, no proper inspection will be made, and the list of casualties from falling bridges will be continued. Unfortunately it is difficult to gain a hearing for the dry details of prevention. In the construction of road bridges provision for a strain of 100 pounds for those of short span to 40 pounds for those of longer span per sq. ft. should be made; in that of railroad bridges the provision should be from 7,000 pounds for those of short span to 2400 pounds for those of longer span per lineal foot. Compliance with these conditions will only make bridges secure for ordinary travel, and it is difficult to obtain them because of the dishonesty of some builders, who construct bridges to sell, and of the ignorance, especially of town and county officers, to whom cheapness, combined with seeming strength is a strong recommendation.

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of the society was held on the evening of Feb. 1, Mr. Charles Macdonald occupying the chair until the arrival of President Welch.

The deaths of Moses Lane, member A. S. C. E., at Milwaukee, Jan. 25, and of A. L. Holley, past vice-president of the society, at Brooklyn, Jan. 29, were announced.

The consideration of the paper by Robert E. McMath on "Mean Velocity of Streams Flowing in Natural Channels," which was read, was postponed.

The following named gentlemen were elected members: Enrique Budge, Chief Engineer and Director New Government Mole, Valparaiso, Chili; Chester B. Davis, Chief Engineer Water-Works, Omaha, Neb.; Robert Gordon, Chief Engineer Irrawaddy River Embankment Works and Survey, Henzada, British Burmah; George S. Rice, Civil Engineer, Charleston, Ariz.; Thomas J. Seely, Div. Supt. and Asst. Engineer Las Vegas Div. Atchison, Topeka & Santa Fe Railroad, Las Vegas, N. M.; Romeo Paul Tomassek, Construction Engineer Mexican National Construction Co., New York City, N. Y.

ORGANIZATION OF THE COLORADO INSTITUTE OF ENGINEERS.

A Leadville paper says: "Feeling the lack of any association of engineers and scientists in this section of the country, the civil and mining engineers and metallurgists of Leadville have organized the Colorado Institute of Engineers. The objects of the association are stated to be the exchange of scientific ideas; the discussion of scientific subjects of interest, which are constantly arising in the practice of the professions represented, and the establishment of a library of standard scientific works. Much care and labor have been employed to make the initiatory steps result in the proper basis for a permanent and reliable association, and, after a number of preliminary meetings, the organization has now assumed such shape as to insure a permanent and useful future.

At a meeting held recently, the following officers were elected:

President—Thomas W. Jaycox.

Vice-President—Charles J. Moore.

Secretary and Treasurer—F. L. Sizer.

Directors—F. Guitermon, A. Falkenau, Max Boehmer.

Librarian—Ellery Stowell.

The next meeting of the society will be held on Thursday evening, Feb. 2, at half-past seven o'clock, in room 11, Howell block.

LIVERPOOL ENGINEERING SOCIETY.

The usual fortnightly meeting, being the last of the session, was held on Wednesday evening, the 4th ult., Mr. A. Holt, M. Inst. C. E., President, in the chair. After the election of officers for the ensuing session and some other business, the retiring President in his address gave a paper on "The Proposed Elevated Railway Along the Liverpool Docks." Mr. Holt remarked that Liverpool was a long, one-sided town, the river and docks forming a continuous straight boundary on the west side, along which personal transit had always been very difficult. The dock omnibuses, through no fault of their own, are very slow and uncomfortable; in fact it is virtually impossible to have a quick and comfortable omnibus service along the Liverpool docks. He had entertained for many years crude ideas of a high level railway to obviate these disadvantages. The works of the Mersey Docks and Harbor Board, under the Act of 1873, being at the extremities, only made matters worse; in fact, Liverpool was fast becoming a two ended town, with all offices, etc., in the center, and the ships at each end, a very disadvantageous condition of things. His attention had been attracted to the New York structure, of which he gave a description. The capital embarked in this undertaking was excessive, and had the natural result—high fares; but it was a great success on the whole, and very considerable increase was proposed. He drew attention to the insecure appearance of the New York structure and doubted if such would be acceptable to the Liverpool public, entertaining the opinion that on the whole a safer appearance would be desirable. In deciding the class of structure to be adopted in Liverpool the much smaller traffic, as compared with New York, should be taken into account. On these and similar grounds he advocated a single line system as sufficient, and the Act of 1878 was based thereon. He described the proposed structure, and touched on the question of having the "trough" or the "American" system of girder, describing both. He also showed the mode of working stations, and economy being necessary, had arranged for the minimum number of employés. The carrying powers of the line, its speed and check on money receipts were alluded to, and estimates of cost and of working expenses were given. The reason why the proposal for a single line has been abandoned was explained, it turned on the question of safety in working the single line station, to which the Board of Trade officer had objected. Mr. Holt pointed out that on certain conditions the single line system was preferable to double line on the ground of safety, and explained, by comparison, the real advantages and disadvantages of single and double line system. His opinion was that though the double system may be, under the circumstances, obligatory, it is evidently an excessive provision for the wants of Liverpool. So strong has been the set of opinion in favor of double line, that it led to the abandonment of single line scheme, and the promotion of a new Act of Parliament for next session. The author then gave a description of the proposed work, explained how the Stanley dock was to be bridged, and the Lancashire & Yorkshire Coal Railway got under, and how headway was provided under the line to take large pieces of machinery to the dock. He concluded with remarks on the general improvement to be expected in Liverpool, and in the method of carrying on the shipping business as the result of the railway when carried out, and touched on the alternative question of communication by tunnel along the docks, which he did not consider so suitable a means of communication as the proposed railway. A vote of thanks to Mr. Holt for his very interesting paper and for the manner in which he had presided over the meetings during the year was carried by acclamation. The President then vacated the chair and Mr. F. Salmon, M. I. and S. Inst., the elected president for the ensuing session, took the chair and addressed the meeting. He announced that the next meeting of the Society would take place Jan. 18, 1882, when a paper would be read by Mr. H. F. Bellamy, on the Plymouth Corporation Water-Works. Votes of thanks to the officers of the Society for their services during the past session concluded the business.

The first meeting of the eighth session of this society was held on the 18th ult., at the Royal Institution, Colquitt street, the President, Mr. F. Salmon, M. I. & S. Institution, in the chair. After the usual business, Mr. H. F. Bellamy read a paper on "The Plymouth Corporation Water-Works."

The author, having called attention to the fact that the antiquity of the present supply of water to the town of Plymouth rendered the subject more than usually interesting, pointed out, on a bird's-eye view of the town, the geographical position of the district supplied with water by the Plymouth Corporation, proceeded to review in detail the history of the present source of supply—passing around photographs of maps of the town made during the reigns of Henry VIII. and Elizabeth, the originals of which are in the possession of the Marquis of Salisbury, in the Hatfield Library. He then showed that prior to A.D. 1590, the chief source of supply was from wells in the town, and that the corporation, finding this supply inadequate, obtained an Act of Parliament—a brief extract of which was given, and which continues to the present day—to introduce a supply from the River Meavy, by means of an open channel or "leat."

By quoting extracts from ancient corporate account books, and exhibiting a copy of the original plan for the construction of the "leat," he showed the cost and mode of carrying out the work, and the system of distribution, and charges made after the introduction of the water.

In describing the present condition of the works, he stated that the original "leat," in a repaired condition amounting almost to reconstruction, was still used for twelve miles of its course, discharging the stream into a service reservoir three miles from the town, from which the water is conveyed by two lines of pipes, 12-in. and 24-in., to the distributing reservoirs two and three miles distant, thereby cutting off seven miles of the old course. He described, by a working drawing, the settling tanks, through which the water passes before entering the reservoirs.

With reference to proposed improvements, he stated that the supply still being inadequate, a storage reservoir of about 350 million gallons capacity is to be constructed within the water-shed of the River Meavey above the Head Weir. The resources of this water-shed he showed to be very great. The pipe line is to be extended about five miles to Roborough Down, and a series of settling tanks and an intake reservoir constructed there.

In conclusion, he gave details of consumption and quantity of water available, the rules and regulations, rates for domestic and other supplies, and analysis of water.

After the paper, which was illustrated by plans, photographs and drawings, had been read, a discussion took place, and a vote of thanks to Mr. Bellamy for his interesting paper was given. The President announced that the next meeting of the Society would be held on the 1st of February, when Mr. Wm. Goldshaw would read a paper on Municipal Control of Streets and Buildings.

THE IRON TRADE.

(Prepared expressly for Engineering News.)

Railroad companies, construction companies and projectors of numerous enterprises requiring vast quantities of iron and steel have about completed their estimates and formulated their plans for 1882. There has been very little to interfere with this preparatory work. Confidence in the permanence of the industrial prosperity has not been weakened by unusual or unexpected occurrences. Capital is abundant, immigration continues and prospective possibilities are favorable. No unfavorable legislation is threatened. The volume of sound currency seems sufficient for all probable requirements. The warnings which have been sounded through the press were based, not on specific evidence, but on general probabilities as to over-investment and over-production, and over-doing in general. Producing and transportation interests are resolved that they shall not be found guilty of short-sightedness in the expansion of facilities to meet the rushing requirement of consumers and exchangers. The closest investigation and inquiry fails to unearth any decline in activity in any of the great avenues of activity. Railroad construction is being as vigorously prosecuted as weather and supplies will admit. Differences of opinion exist as to the probable amount of railroad building that will be accomplished this year, but thus far no facts are at hand to modify recent utterances on this subject. For several weeks demand has seemed to fall off in American mills, but the falling off is due to their oversold condition and not to lack of demand. In fact, these mills could accept business now or at any time, sufficient in volume to carry them far into 1883. This might be done if steel rail manufacturers had control of the sources of raw material, but as they are obliged to come into the open market and bid against the world for material to fill contracts they are obliged to limit engagements to their probable ability to cover them. In addition to this the activity in railroad construction at home and abroad has not reached a climax, and prices exhibit generally an upward tendency. Recently, however, steel rails have declined, and offerings are made at mill of $55, foreign at tide $56@$57, while Bessemer pig has sustained a sharp decline, under which an active demand has sprung up. These facts justify conclusions and inferences presented weeks ago that railway material would decline eventually, and that the decline would stimulate enterprises and engineering work all over the country. Within two weeks inquiries have been made at the leading iron centers for large supplies of iron and steel for spring, summer and fall delivery. Bridge work, pipe work, and railway construction requirements are the leading items. The present indications are that a very large amount of work of this character will be placed.

There have been rumors of fluctuating values, of sharp advances, of heavy importations, but the bulk of these rumors have no foundation. The bridge works East and West are overcrowded, and will soon have the opportunity presented of extending engagements. The plate and tank mills have been refusing summer contracts, and are crowded with high-priced contracts between 3½c. for common to 5c. for flange iron. Customers are soliciting an indefinite continuance of engagements. The recent course of pig-iron has created more or less uncertainty in the minds of manufacturers as to what is really best to do. Contractors desire to know fixed prices. Crude iron is $2 per ton higher than when existing contract work was taken. This is a serious matter. A decline of $2 is not an impossibility if a score or two cargoes of English iron were to be unloaded here. Nor is it sure any harm would follow because of the unusual foreign activity. Still there is some uncertainty, and it is the only unfavorable feature in the entire situation. The general tendency is to book orders subject to market fluctuations, but this method, while checking the upward tendency, has its defects. Production meanwhile is steadily increasing at furnaces and mills, while consumption is following closely on its heels. The great enterprises are not taking alarm, and it is not probable that imaginary difficulties will be permitted to interfere with the carrying out of the large number of projected works, larger than ever engaged the skill and energy and capital of the nation.

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FACTORS OF SAFETY.*

BY ALBERT F. HILL, C. E.

Recent structural failures of bridges, marine engines, boilers, etc., followed by ghastly reports of coroners' inquests in the daily press, and by more or less scientific discussions as to their causes in the technical journals, have lately brought the term "factor of safety" prominently before the public.

In the present general acceptation of the term the factor of safety expresses the ratio between calculated maximum strain and ultimate or breaking strength of the material employed in a given structure. For instance, wrought iron is conventionally assumed to have an ultimate tensile strength of 50,000 pounds per square inch; if the greatest calculated stress upon it, in a given structure, does not exceed 10,000 pounds per square inch of its effective section, the iron is said to be used with a factor of safety of five, or in common parlance, to be "five times as strong as the greatest load that can come upon it." That this conclusion is an absolute fallacy, is well known to modern engineers, but its pernicious influence is hardly fully appreciated as yet. It gives not only a very undesirable latitude to incompetent designers, but also encourages unscrupulous manufacturers to take large risks, especially under the spur of close competition; it misleads that class of laymen who, either by their official position or as capitalists, are interested in the carrying out of public works; and finally, it is to-day the fruitful source of disasters, brought about by unreasonable—one might almost be tempted to say brutal—tests of structures. Take, for example, our so-called "hydraulic test" of steam boilers. A perfectly new—or, for that matter, old—boiler pumped full of cold water under a pressure far in excess of any steam pressure it will ever have to bear! Is there any analogy between the test and the work required of the structure? And when this brilliant experiment is finished, can anybody tell the possible—and probable—amount of injury done to a previously good and serviceable boiler? All we know is, that "recently inspected" boilers do most unaccountably burst. These tests would never be carried to the excess to which they are but for the fallacious idea of our margins of safety. In the same unreasonable manner are bridges often overtested; loads and shocks are applied to them far in excess of any which the traffic ever can or will bring upon them, and this before an opportunity was given the different parts to assume their working bearings. These excessive strains, while they do not cause immediate failure, do cause, in many cases, permanent and not easily discoverable injury, which only becomes apparent through some "unaccountable" failure.

The responsibility for the fallacious conceptions of our margins of safety, or safety factors, rests mainly upon the inexact but hitherto accepted method of ascertaining the ultimate or breaking strength of materials. This method—employed by the earliest investigators—consisted in taking pieces of constructive materials of any square unit of section and breaking them by gradually increasing loads. Bars of iron, steel, wood, copper, etc., of given lengths and, let us say, of exactly 1 sq. in. of section, were thus broken, and the average of the loads which caused rupture in the bars of the same material was then fixed upon as the ultimate or breaking strength of that material. It is self-evident that these results do not represent the ultimate or breaking strength of the material, but simply the one load which at a single application will produce rupture. A somewhat lesser load, applied several times in succession, would also have produced rupture, a fact of which everybody is cognizant and of which we avail ourselves instinctively when endeavoring to break a string or a stick, etc. If not successful in the first application of muscular force, the attempt is repeated until fracture is effected. The muscular force in these successive attempts not being increased, and the first force applied not being equal to the breaking load, shows that a lesser load by sufficient repetition has at least produced rupture. This opens at once the question, what then is the ultimate strength of materials?

Modern investigations and experiments, conducted with great care, improved testing machines, and covering a wider field of observations than was formerly deemed necessary, have established the following facts, viz.:

1. Successive increments of load put upon bars of any constructive material will produce elongation of the bar.

2. These elongations will be proportionate to the loads, and uniform for uniform increments of load up to a certain limit.

3. Within this limit of load the bar, when released from its load, will return to its original length.

4. When this limit is once exceeded and the bar then released, it will not fully recover; a permanent elongation, called "set," will be found to have taken place.

5. After permanent set has taken place, the elongations become irregular, greater and greater for equal successive increments of load, and every successive load will also increase the amount of permanent set, until rupture finally takes place.

6. *Any load in excess of the one producing permanent set will ultimately produce rupture, if sufficiently often repeated.* The number of repetitions necessary to produce rupture decrease in proportion to the increase of load, until finally a load is reached, the single application of which produces rupture.*

The point at which permanent set takes place has been designated as the limit of elasticity of the material; but, in fact, the limit of elasticity is not reached at that point at all, but lies invariably very near the breaking point, for after permanent set has taken place successive increments of loads, if removed, will still show partial recovery of length in the bar, though with a constantly increasing set, until at last a point is reached where no recovery of length takes place—now elasticity is destroyed or its limit reached—and from that point on a comparatively very small force suffices to pull the bar apart. The permanent set is therefore indicative of the point of permanent injury to the material, rather than of its limit of elasticity. Having thus shown that what is at present called the breaking strength is as arbitrarily chosen and as meaningless a quantity as the zero point of a Fahrenheit thermometer, and, therefore, almost worthless when used as the standard to which factors of safety are to be referred, and having further called attention to the fact that the term limit of elasticity is rather a misnomer, it is now proposed to inquire what influence would be exercised upon the prevalent ideas of margins of safety, and consequent methods of proportioning structures, by a proper nomenclature expressive of the available strength of material to resist stress.

Remembering that any load in excess of the one producing permanent set will, by sufficient repetitions, produce failure, it would seem pretty clearly indicated that the working usefulness of the material is limited by the load at which set takes place. This being the case, we may properly say that *the load under which permanent set first takes place is the equivalent of the ultimate working or safe strength of the material.* This safe strength differs in ratio to the so-called breaking strength in different materials, varying in amount from 30 per cent. to 60 per cent. of the latter. For example, in wrought iron it will be found that permanent set takes place at from 25,000 to 28,000 pounds per square inch of section, thus reducing the supposed safety factor about one-half. It is true that this is ample for most cases, and even more than is necessary in some. What, then, may be asked, is gained by the proposed change? If nothing else, the true margin of safety is substituted for a false one, and with this, in many cases perhaps, the temptation removed to speculate, as it were, upon fictitious assets. But that this is not the only gain is easy of demonstration. A full appreciation of the true safe strength of the material cannot fail to call out a closer inquiry into the proper functions of safety factors—*i. e.*, what they are intended to cover, and what they never meant to cover.

There is no denying the fact that even at the present day there is in many minds a vague idea that safety factors are a sort of mechanical charity intended to cover a multitude of sins, both of omission and commission. In this may be found the reason for the deliberate overloading of many bridges designed years ago for the passage of locomotives and rolling stock such as were then in use; but since then the concentrated loads on drivers, weight of rolling stock and traffic have nearly doubled, yet such bridges are left in use to-day without any attempt at properly strengthening them for these increased loads. Nothing but misconception of the true margin of safety is chargeable with this neglect. For the same reason, tedious and sometimes difficult calculations of details and connections are often neglected in the first place by designers; "common practice" is blindly followed, without investigation as to whether it is properly applicable to the case in point, and any qualms of conscience are stilled with the answer, "Our factor of safety is sufficient." Manufacturers will use material not in accordance with specifications, and console themselves, and the inspector also, with the assurance that the safety factor is meant to cover just such deficiencies. Add to this the necessarily more or less imperfect workmanship—for structures like bridges, engines, boilers, etc., cannot be put together with the nicety to be found in an astronomical instrument—and it will be seen how easy it is to overburden the safe strength. Call it dealing in truisms to repeat here that the weakest point of a structure is the exponent of its strength, yet it will be safe to assert that this old maxim has not been quite as often uttered as it has been overlooked and disregarded.

If full and proper weight is given to the fact that the point of permanent set is the limit of the working capacity of the material, no matter how much more force may be required to produce rupture after that point is passed, and also that within that limit lies perfect safety, it cannot but lead to more rational methods of dimensioning than are at present generally adopted. With it will come a better understanding of the difference in the effects of live and dead loads, and consequently, methods of dimensioning of the different parts of a structure in accordance not only with the amount of combined dead and live load, but also in accordance with the ratio between the dead and live loads they are meant to resist. This in turn must lead to the avoidance of superfluous weight—always detrimental to any structure—a more careful concentration of material along the line of strains, the better strengthening of details—especially connections—proper modification of shapes and dimensions in those parts particularly subject to shock, and last, but not least a proper taking into account of the facilities of the manufacturer, which determine in a large measure the character of workmanship, and ought to influence the adoption of a lesser or greater margin of safety.

Our representative bridge works and machine shops have, more or less, for some time past adopted improved methods of proportioning and dimensioning, and are constantly experimenting and improving, but it must, on the other hand, be admitted that their number is limited and the amount of work turned out by them small in comparison to the immense production of structural work going on all over this country.

Factors of safety will always be needed and therefore will always be provided in construction. But because we cannot, for instance, always provide against the phenomenal effects of hurricanes and tornadoes this is no reason why perfectly calculable wind pressures should be left out of consideration and be vaguely saddled upon the safety factor. Imperfections of material, however carefully selected, inspected and manufactured, will never be fully obviated; but this is no reason why material known to be flawed should ever be permitted to enter a structure on the plea that the factor of safety will cover the deficiency. Perfect workmanship is, of course, out of the question, but this is no reason for relying upon the safety factor to make up for positive carelessness and negligence in the shop. Let us hope that the near future will eradicate from all our structures bad proportions, bad connections, bad workmanship, in short, all that is ascribable to "Trust in Providence and—a large factor of safety."

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CONTRACTORS AND ARCHITECTS.—The demands of the contractors for certain changes in the printed agreements which are furnished by architects for signature, previous to the commencement of work, have not as yet been agreed to. In fact, it is doubtful if the architects will agree to the conditions sought to be imposed at all. One of them is that in case of dispute for extra work arbitrators be appointed—one by the contractor, one by the architect and another by the proprietor of the building. Thus the architect's claim would cause a great deal of useless labor and annoyance. They claim that in all the leading cities the matter of extra pay is left in the hands of the architect, and they do not see any necessity for having an exception made in the case of London. In the meantime the contractors have had a lengthy set of rules drawn up by W. R. Meredith, Q. C., and submitted to the architects. It is stated they will not tender for any work offered by those architects who refuse to agree to the terms laid down by them.—*London (Ont.) Gazette Jan. 30.*

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* *From Mechanics, Jan. 28.*

* These phenomena of tensile strength hold good also in a general way in reference to compressive, transverse, shearing and torsional resistance. The foregoing observations are borne out by the experiments of Wohler, Spangenberg, Barba, Kirkaldy, Thurston, etc., and were verified by over 2,000 tests made by the writer on iron, steel and wood, and comprising specimen tests as well as tests on full-sized bridge members.

REPORT ON RAILROAD SAFETY SIGNALS.

To the Railroad Convention, held at the St. Nicholas Hotel, New York, Oct. 17, 1866:

The Committee on Safety Signals and Regulations present some general principles which they deem important, and which can be applied according to the circumstances of each road.

Where there is great liability to a break in the track, or such obstruction upon it as would cause serious disaster if undiscovered, such as at a draw-bridge, tunnel or crossing at grade of another railroad, the thing should be presumed to be wrong until the engineer has affirmative evidence that it is right; that is to say, in such cases safety signals should be used and never danger signals. If a danger signal is relied upon, and if from defect of apparatus or negligence of the signal man or of the engineer, or if from fog, smoke or any other cause, the danger signal is not made or not seen, the result may be a terrible accident, but when a safety signal is relied upon, then if not made or not seen, the worst that can happen is a momentary stoppage of the train. In such cases a danger signal should not be used in connection with the safety signals, because engineers become accustomed, after a while, to look for it, and then if it should not be seen they might presume all right and disaster might ensue.

The correctness of the foregoing principle was strikingly shown by the terrible catastrophe at Norwalk draw-bridge, several years ago. If the train had been required to stop when there was no signal shown that the bridge was right, no harm would have been done; but the engineer, depending upon a signal that the bridge was wrong which he did not see, ran into the river.

In a recent case in England three freight trains formed a single heap of burning ruins in the middle of a tunnel. The notice that the first train that entered had broken down, was not sent or not received, and the second train ran into the first and the third into the ruins of both. If the principle above laid down had been in use, and the engineer instead of looking for evidence that the tunnel was obstructed, had not gone on till he had evidence that the tunnel was clear, no accident would have happened. Neither would the adoption of the safety signal plan in that case have been attended with any increased expense or delay.

We call special attention to this point, because on a great many roads a contrary principle is acted upon, and because so many good railroad men never thought of the difference, and because serious accidents are so frequently happening which would be prevented by the plan we recommend.

Of course there are many things which the engineer must presume to be right until he hears or sees them to be wrong, such as the general continuity of the track, the safety of the permanent bridges, etc. Other things, such as draw-bridges, etc., are so liable to be wrong, and the disaster, if they are wrong, so serious, that they should always be presumed to be wrong till they are proved to be right. What things should be presumed to be right and what wrong will depend upon the degree of risk and the circumstances of the different roads.

On important double track lines of railroad we recommend that telegraphic signal stations should be established at intervals somewhat less than the shortest that are permitted between trains going in the same direction, and each train on passing such station should be informed by signal that the preceding train going in that direction has passed the next signal station, or, in the absence of such information, stop for explanation or proceed under proper regulations, expecting to overtake a disabled train. The display of a danger signal for a given number of minutes after the passage of a train is not sufficient, for the attendant may neglect to make it, the engineer may fail to observe it, or if made and observed, and the proper time has elapsed, the preceding train may be broken down, and in the confusion attending upon an accident no warning may be sent back, or if sent back may not be seen. These are not mere possibilities but things of frequent occurrence. Notwithstanding the use of torpedoes and other danger signals sent back from disabled trains, we often hear of accidents by failure to observe them.

Probably, not one cause of disaster is so frequent on the main lines of railroad as one train running into the rear of another. It seems to us the plan proposed ought to prevent such accidents, or at least to render them very infrequent.

Such a plan has been in use for a year past between Philadelphia and New Brunswick, on the main passenger route between Philadelphia and New York, and experience confirms our confidence in its value. The signal used in this case is a white board, and a white light at night shown through an orifice two feet in diameter, in a black signal box, so placed that it can be seen as far as possible. A partition in the box separates the signals for the opposite directions. The signals are exhibited to the approaching train by the attendant at the telegraphic instrument pulling a cord, and then the moment the engine passes letting it go, when the signal drops into the lower part of the box out of sight. One important precaution is that the signal should never under any circumstances be fastened up, as there would then be a possibility of its being neglected and showing a clear track when it should not.

It is necessary to have a separate telegraph wire for this purpose not liable to be used for anything else.

As a train passes a *counter* is used to represent it. This is removed when the train is reported past the next station. Nothing is left to the memory or the judgment of the operator.

Draw-bridge and switch signals should not be in the hands of men, but connected with the structures themselves, so that they cannot show right when the thing is wrong, and they should be so contrived that if out of order they will be out of sight; their absence will then require the train to stop and examine.

For twelve or fifteen years past there have been used on the Belvidere & Delaware Railroad draw-bridge signals, which can only be exhibited by the insertion of the bolt which fastens down the latch of the bridge, and thus insures the continuity of the track.

There have also been used on the same road during the same period, for switch signals, large parallelogram surfaces uniform for the whole road, on each of which is painted a long white cross on a red ground, directly connected with the main switch and by a long wooden rod with a movable short switch, used instead of a frog. No engineer can mistake the position of the signal, and therefore of the switch, at a mile distance. Many who have observed these signals for years consider them in some situations safer without an attendant than an attendant and his flag without the self-acting signal.

An excellent revolving switch signal is in use on the Erie Railway and probably on many other roads, in which a white pointer, or by night a white light, indicates that all is right for the main track. Perhaps they would be better without the red pointer, which shows that the switch is wrong and which the engineers may get into the habit of looking for, and when, from any cause, they fail to see it, may erroneously presume the switch is right. They should regard only the safety signal.

The following plan of signal to prevent collisions on railroads crossing each other at grade has, after much consideration, been adopted at the intersection of the Philadelphia & Trenton and the Reading railroads. On the former trains are passing very frequently. On the latter trains of cars are passing every few minutes. A hollow cylinder, elevated so as to be seen by all concerned, has four openings, one each way for each road. Through these a revolving cylinder is seen, with a light in it by night, on which two opposite spots are white, all the rest red. When white is seen through openings, towards one road, allowing its trains to proceed, red will be shown through the other, and while it is being shifted, or when no train is approaching, red will be seen through all. No train is to proceed till the white is shown.

Signals should be at known and conspicuous points where they will be always looked for, and therefore most likely to be observed; for example, if the track is disturbed, notice should be shown at a telegraph station or other point where it will be looked for, as well as near the spot.

Signalmen should be so circumstanced as to be kept cool and alert, not distracted by too many engagements, and comfortably sheltered. A brakeman sent back with a red light with the thermometer ten degrees below zero is a very unsafe guard against danger.

When discretion must be used by any one, it should be by the engineer rather than by the signalman, as the former is presumed to be a superior man and has more at stake.

Signals should be simple and not repeated. An engineer going forty miles an hour can attend to and understand one signal when he might be confused by two.

Colors should be used which can be seen the farthest; that is, red and white, and these combined in such well-known forms that they cannot be mistaken for any other object of the same colors seen in the same direction.

Flags are less safe than globes or flat surfaces, for they are liable to be blown edgeways to the observer.

Signals and safety regulations should be uniform for each road, and as far as possible for all roads, especially for those connected with each other. The apparatus and mode of working should be minutely described and carried out with precision. As little as possible should be left to discretion. Emergencies should be provided for by rules deliberately made.

The clocks at all railroad stations should be set daily, or at least frequently, by telegraph from the standard clock. They should not be unnecessarily multiplied for fear that some may be left wrong, and so mislead. It is a good plan for watches carried by each conductor and engineer to belong to the company, and be delivered to a time clerk on arrival at each end of the route, to be set right by him and received from him at departure, and compared with the clock both by him and the person carrying it. Allowance of a minute or two or more should be made for error in time before a train should run on the time of another which has lost its right. As far as practicable connected roads should use the same time.

All which suggestions are respectfully submitted.

ASHBEL WELCH, Chairman.

DESCRIPTION OF THE GRANITE BLOCK PAVEMENT LAID IN WESTMINSTER STREET, IN THE CITY OF PROVIDENCE, R. I., DURING THE FALL OF 1880.*

Westminster street is located in the central portion of the city. It is one of the busiest thoroughfares. During the day it is thronged with vehicles of all descriptions. Still the tonnage passing over it is not so great as in some of the other streets. The abutting property is occupied by the best retail stores in the city, consequently it is a great resort for persons desirous of trading or promenading. It is the main line for all horse cars running to the westerly and southerly portions of the city.

Owing to the constant use of this street, both for vehicles and pedestrians, it was desirable to lay that pavement which possessed most of the points of a perfect one. After deciding upon the plan and material, each detail in the performance of the work was carefully executed. The only drawback on the work was the lateness of the season. To obtain the best results the work should have been performed during the months of July and August, but owing to unavoidable delays it was postponed to September and October.

The total width of the street between building lines is 48 ft., the sidewalks being each 12 ft. wide, leaving 24 ft. for the roadway. The length of the street paved was 2,621 ft. On about three-quarters of the length of the street the grade of the curbstone is very slight, being about $\frac{34}{100}$ per 100 ft. The grade of the roadway was increased to a rate of $\frac{43}{100}$ per 100 ft. by making summits and depressions, except on the line of the railroad track, which was set nearly parallel to the curbstone. A catch-basin, connected with the sewer, was built at each depression for carrying off the surface water.

A plan of the street was made upon a large scale, showing the grades and the roadway elevations. These elevations were marked out upon the roadway at intervals of 20 ft. longitudinally and 4 ft. transversely.

The following is a detailed description of the work, given in the order in which it was performed on the street:

The blocks were brought upon the street and inspected. The accepted ones were then piled upon the sidewalk, in piles of such size as to be sufficient to cover the roadway opposite. The rejected blocks, when admissable, were trimmed over by a block-cutter; all others were condemned and removed from the work. The accepted blocks were of a durable, sound and uniform quality of granite, each measuring on the face or upper surface not less than 8 in. nor more than 12 in. in length, not less than 3 in. nor more than 4 in. in width, not less than 7 in. nor more than 8 in. in depth. They were split and dressed so as to form, when laid, end and side joints not exceeding 1 in. wide at the top or bottom.

The cobble-stone pavement, with which the street had been paved for the last 50 years, was then taken up and removed from the roadway; the earth was excavated to a depth of 14½ in. below the finished top of the pavement, care being taken not to excavate below said grade, and plowing was prohibited except to merely loosen the cobble pavement.

After the roadway was excavated, rammed (when required) and trimmed to the sub-grade, the materials for the concrete were placed upon it. The proportions used were one part of fresh ground American hydraulic cement of the best quality, capable of resisting a tensile strain of 50 lbs. per square inch after 30 minutes exposure in the air and 24 hours in water, two parts of clean, sharp sand and six parts of screened gravel of a size that would pass through a 2½ in. ring. These proportions were mixed into concrete in the following manner: Two barrels of sand were emptied in a pile on the ground, the top of the pile was broken off and one barrel of cement spread equally over it. The sand and cement were turned over twice by shovelers, so as to thoroughly mix the same, care being exercised to keep the space between the piles clean while turning them. A basin was then formed by drawing all the material to the outer edge of the heap and water was poured into the basin; the mixture was then stirred with hoes until it was made of the proper consistency. Six barrels of wet screened stone were emptied in a heap near the mortar, the two piles were then shovelled together so as to mix the mortar and gravel proportionally; in this case one scant shovel of mortar was thrown to two shovels of the stone.

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* From advance sheets of City Engineer's Report for 1880.

The mortar and gravel were left upon the road-bed in such a manner that, by the process of mixing, the piles had occupied most of the area that the concrete would cover when in place, thus assisting in settling the road-bed.

The concrete, when in place, was rammed and thoroughly compacted, leaving a clear mortar surface parallel and 9½ in. below the grade of the top of the finished pavement, giving a depth of 5 in. of concrete. This was the uniform depth throughout the street, except at some street intersections, where, on account of the increased traffic, it was put in to a depth of 7 in.

In tamping the concrete slight trenches about 2 in. deep were formed under where the stringers for the railroad were to come. In these depressions stringers 9 in. deep of hard pine, creosoted, were placed; these were fastened together by iron tie rods about 5 ft. long and 4 in. wide, turned up at each end and spiked to the stringers. The track was then brought to line and grade.

The space under the stringers was then carefully filled with mortar, taking care to fill the depression each side of the stringer, and also leaving about 1 in. of the stringer embedded in concrete.

Thirty-six hours were required for the concrete to set before allowing any work to be done on it.

In placing the blocks next to the rails care was taken to have each stone bear solid against the rail, leaving them, on the outside of rail, about ⅝ in. above and on the inside between the rails about ⅝ in. above the top of the rail.

On the concrete foundation was laid a bed of clean, sharp sand, free from moisture, about 1½ in. in depth, or sufficient thickness to bring the pavement to the proper grade when finished.

The granite blocks were set in this bed of sand at right angles to the line of the street; the ends were placed as close as possible to one another, making the joints lengthwise of the street as small as the stone would allow, while transversely the joints were opened from ⅛ to ⅜ of an inch at the top. Each course was formed of blocks of uniform width and depth, and so laid that all longitudinal joints were broken by at least a lap of 2 in. The blocks, to within three courses of the pavers, were kept covered with clean, hard gravel, artificially dried, which had been passed through a ⅜-in. sieve and retained by a ⅛-in. sieve. When this gravel had been well brushed into the joints, the blocks were thoroughly rammed with a two-handled vertical rammer weighing about 25 pounds. As the gravel was shaken down more was added and the ramming repeated; this process was continued until each block was perfectly firm and the joints left full, which was usually accomplished on the second ramming.

The surface of the block was left true to the crown of roadway. The joints were then filled with an asphaltic mixture composed of coal, tar, pitch and creosote oil, in the proportion of about 60 gallons of oil to 2,000 pounds of pitch. The mixture was heated in a portable boiler holding about 200 gallons when two-thirds full and having a faucet in the lower end for drawing off the liquid into buckets holding about two and a half gallons when two-thirds full; these buckets were provided with spouts of such size that the workmen could pour the mixture directly into the joints. The temperature of the tar in the buckets when ready to pour was over 325° Fahrenheit. On account of the lateness of the season, the gravel and blocks being cold, it was found the asphaltum mixture did not sink into the joints as far as was desirable, and in order to assist it before using the asphalt, the joints of the pavement were run over with a very small stream of creosote oil; about one-tenth of a gallon was used to each square yard of pavement. The asphalt was then poured into the joints until they were filled to overflowing. After about 100 yards had been thus completed the workmen returned and refilled the joints, the asphaltic mixture having in the meantime settled into the interstices of the joints; the process was repeated over the same area until the asphalt would not settle further and the joints were left full. The pavement was then covered with a thin layer of coarse, sharp sand and thrown open to travel. The stone for the pavement, the sand for the bed and the gravel for the joints were each and severally laid only when free from moisture.

The work of paving the street was begun Sept. 7, 1880, and completed Nov. 4, 1880. The total square yards paved was 7,255, or an average of 181 square yards per day for each day worked. The greatest number of square yards laid in one day was 220.

The apportionment of labor, exclusive of the excavation and the block inspection was practically as follows:

MIXING AND MANIPULATING THE CONCRETE:
Shovelers, 8 men; Rammers, 2 men.
BLOCK PAVING:
Pavers, 8 men; Rammers, 2 men; Helpers, 3 men.
FILLING JOINTS:
Shovelers and brushing gravel, 3 men; Pouring asphalt, 2 men.

The contractors' prices for doing the work were as follows:

For taking up and removing the present pavement	$ .05	per sq. yd.
For all earth excavation, measured in place	.48	" cu. "
For furnishing and laying concrete	2.50	" " "
For furnishing and laying new cross-walk stone (2 ft. strips), including a bedding of sand	.60	" sq. ft.
For taking up, dressing, relaying old cross-walk stone	.10	" " "
For furnishing and laying granite blocks, including the sand bed	1.98½	" sq. yd.
For furnishing and filling the joints with gravel and asphalt	.27½	" " "
Total cost per square yard, including concrete foundation, sand bed, blocks, gravel and asphaltum for joints and all labor necessary therefor	$2.82	

The entire work, aside from laying the horse-car track, was done under contract by Messrs. Booth Brothers, 65 Bank street, New York, superintended by Mr. Sheriff.

In regard to the quality of the work, I can say of it what I have seldom been able to say. It was done in all its parts to my entire satisfaction, and that without any trouble. The superintendent spared no pains in seeing that all material and labor were performed fully up to the specification, excelling, if possible, even the inspector in his care of the same. No settlement or other imperfection was found in the pavement after the daily area of about 181 square yards was thrown open for traffic, a fact quite unusual for this length of street, especially when it is understood that the road-bed was opened nearly two-thirds of its length for the repairs and connections of gas, sewer, and water pipes just previous to the laying of the pavement.

It may be a matter of surprise that the work was let for such reasonable figures—about $2.80 per square yard—and that the contractor received a fair profit; but to one familiar with the locality it is easily understood. All the sand and gravel were obtained from an excellent bank within ⅝ of a mile of the street, nominally at the cost of the labor in screening and carting to the street.

The dumping ground for the excavation was within ⅛ of a mile of the street and near the freight depot, so that the carts brought back the blocks; then the weather was about perfect, there being but one rainy day during the eight weeks while the work was being done.

The pavement, which has been laid about 14 months and subject to one severe winter and part of another winter, has shown no signs of defects and is giving perfect satisfaction. S. M. Gray.

THE GREAT RAILROAD MANIA OF 1845.

In view of the immense interest manifested at the present day in all sections of the country in the prosecution of vast railway enterprises, it may not be inapropos to offer to the public a few words of warning, of which the following account of "The Great Railway Mania Day" in England will point the moral:

Never had there occurred, in the history of joint stock enterprises, such another day as the 30th of November, 1845. It was the day on which a madness for speculation arrived at its height, to be followed by a collapse terrible to many thousands of families. Railways had been gradually becoming successful, and the old companies had in many cases bought off, on very high terms, rival lines which threatened to interfere with their profits. Both of these circumstances tended to encourage the concoction of new schemes.

There is always floating capital in England waiting for profitable employment; there are always professional men looking out for employment in great engineering works; and there are always scheming moneyless men ready to trade on the folly of others. Thus the bankers and capitalists were willing to supply the capital; the engineers, surveyors, architects, contractors, builders, solicitors, barristers and parliamentary agents were willing to supply the brains and fingers, while too often cunning schemers pulled the strings. This was especially the case in 1845, when plans for new railways were brought forward literally by hundreds, and with a recklessness perfectly marvelous.

By an enactment in force at that time, it was necessary for the prosecution of any railway scheme in Parliament that a mass of documents should be deposited with the Board of Trade on or before Nov. 30, in the preceding year. The multitude of these schemes in 1845 was so great that there could not be found surveyors enough to prepare the plans and sections in time. Advertisements were inserted in the newspapers, offering enormous pay for even a smattering of this kind of skill. Surveyors and architects from abroad were attracted to England; young men at home were tempted to break the articles into which they had entered with their masters, and others were seduced from various professions into that of railway engineers.

There were desperate fights in various parts of England between property owners who were determined that their land should not be entered upon for the purpose of railway surveying, and surveyors who knew that the schemes of their companies would be frustrated unless the surveys were made and the plans deposited by Nov. 30. To attain this end, fraud, force and bribery were freely made use of. Nov. 30, 1845, fell on Sunday; but it was no Sunday near the office of the board of trade. Vehicles were driving up during the whole of the day with agents and clerks bringing plans and sections. In country districts as that day approached, and on the morning of the day, coaches and four were in greater request than even at race time, galloping at full speed to the nearest railway station. On the Great Western Railway an express train was hired by the agents of one new scheme; the engine broke down, the train came to a standstill and was run into by another express hired by the agents of a rival project; the opposite parties barely escaped with their lives, but contrived to reach London at the last moment. On this eventful Sunday there were no fewer than ten of these express trains on the Great Western Railway, and eighteen on the eastern counties. One railway company was unable to deposit its papers, because another company surreptitiously bought for a high sum twenty of the necessary sheets from the lithographic printer, and horses were killed in madly running about in search of the missing documents before the fraud was discovered. In some cases the lithographic stones were stolen, and printers were bribed by large sums not to finish in proper time the plans for a rival line. One eminent house brought over 400 lithographic printers from Belgium, and even then all the work ordered could not be executed. Some of the plans were only two-thirds lithographed, the rest being filled up by hand. However executed, the problem was to get these documents to Whitehall before midnight of November 30. Two guineas a mile were in some instances paid for post-horses. One express steamed up to London, 118 miles, in an hour and a half. An established company having refused an express train to the promoters of a rival scheme, the latter employed persons to get up a mock funeral cortege and engage an express to carry it to London and plans and sections came in the hearse, and solicitors and surveyors as mourners! Copies of many of the documents had to be deposited with the clerks of the peace of the counties to which the schemes severally related, as well as with the Board of Trade; and at some of the offices of these clerks strange scenes occurred on that Sunday. At some places the doors of the offices were not opened, as the officials considered the orders which had been issued to keep open on that particular Sunday, to apply only to the Board of Trade; but a crowd of law agents and surveyors assembled, broke the windows, and threw their plans and sections into the office. At the Board of Trade extra clerks were employed on that day, and all went smoothly till nine o'clock in the evening.

A rule was laid down for receiving the plans and sections, hearing a few words of explanation from the agents, and making certain entries in books. But at length the work accumulated much more rapidly than the clerks could attend to it, and the agents arrived in greater numbers than the entrance hall could hold. The anxiety was somewhat allayed by the announcement that whoever was inside the building before the clock struck 12 should be deemed in good time. One agent arrived while the clock was striking 12, and was admitted. Soon after a carriage with reeking horses drove up; three agents rushed out, and finding the door closed, rang furiously at the bell; no sooner did a policeman open the door to say that the time was past than the agents threw their bundles of plans and sections through the half-opened door, and the policeman threw the documents out into the street. The baffled agents were nearly maddened with vexation, for they had arrived in London in good time, but they had been driven about hither and thither by a post-boy who did not, or would not, know the way to the office of the Board of Trade.

The London *Times* soon after devoted three whole pages to the elaborate analysis of the various railway schemes brought forward in 1845. They were no less than 620 in number, involving an (hypothetical) expenditure of £560,000,000, besides 643 other schemes which had not gone further than issuing prospectuses. More than 500 of the schemes went through all the stages necessary for being brought before Parliament; and 272 of those became acts of Parliament in 1846—to the ruin of thousands who had afterwards to find the money to fulfill the engagements into which they had so rashly entered.

CORRESPONDENCE.

WHAT IS "GRADING"?

Denver & Rio Grande Western Railway Co.,
Field Engineering Department,
Price River Cañon, Jan. 30, 1882.

Editor Engineering News:

I give below a copy of the specification for "grading" in use on this road:

"Under the head of grading will be included all varieties and forms of earthwork, such as excavations and embankments for the formation of the road-bed; the cutting of all ditches or drains about or contiguous to the line of the railway; excavations for bridges, culverts and walls; all excavations and embankments necessary for reconstructing public highways destroyed or interfered with in the construction of the railway, as well as similar works for private crossings; the construction of which may be ordered by the engineer, and all other excavations or embankments connected with or incident to the construction of said railway."

Frank P. Davis.

THE METRIC CHAIN.

Cold Spring, Putnam County, N. Y., Feb. 1.

Editor Engineering News:

Being one of those who are anxiously looking for a release from our present confusion of weights and measures, I take a lively interest in anything pertaining to the meter. As a railway engineer, I take especial interest in the question of standard metric chord now under discussion in your columns. It seems to me very important in order to prevent confusion and secure uniformity of practice that a standard length of chain and chord should be adopted for railway work. Also that this standard should be the best possible length to suit the purpose for which it is to be used. I have given the subject much thought and study, and am convinced that, everything considered, 20 meters is that best length; that it is in harmony with the general theory of the metric system, and that, absolute length considered, it is probably the most desirable that could be adopted. One hundred feet is absolutely too long; the chain is unwieldy to handle, and the distance between stations is too great, especially on curves and on bad ground. One of the strong points of the 20-meter station is the ease with which its solid contents can be found.

When the method of averaging end areas is used, and in 49 cases out of 50 that is the fairest method of measurement, you have only to add the two end areas and annex a zero to the sum, or remove the decimal point one place to the right, as the case may be, integral or fractional, and you have the contents in cubic meters at once. Very simple, you must admit, as compared with the tedious operations necessary in our foot-yard arrangement (it cannot be called a system) in order to get the contents in commercial form. Why, my dear sir, just think of it. Since railways were first invented there has been time enough wasted in dividing by 27 to build a road around the globe! Another important point of superiority of the 20-meter chord is to be found in the facility with which the deflections for odd sub-chords can be computed. To illustrate, suppose in running a 2° curve you wish the deflection for 7 meters: 2° = 120′ ÷ 20 = 6′ ÷ 2 = 3′ = def. for 1 meter, and 7 × 3′ = 21′ = def. for 7 meters. In practice a curve could usually be chosen of such a degree that when reduced to minutes it would be a multiple of 20, as for example: 1° 20′, 1° 40′, 2° 00′, 2° 20′, etc. A 25-meter chord could not be used with the same facility because 60 is not a multiple of 25.

In keeping the level and transit notes I would have a double column for the stations, as shown below:

Stations.	Sub-Stations.
	20
52	
	80
	60
	40
	20
51	
	80
	60
	40
	20
50	

Consider the stations proper to be 100 meters long, then 10 stations make one kilometer, in which denomination the gross lengths of road should be designated. Call the 20-meter distances sub-stations or pluses. In the first column keep the stations, and in the second the regular 20-meter pluses and such other ones as the nature of the work and ground requires. On random lines and on preliminaries on smooth, easy ground, it would only be necessary to set stakes every 100 meters, while on rough, difficult ground, and on curves and on location generally the 20-meter sub-stations fit in very nicely. The regular sub-stations being shorter, less irregular ones would be required on bad ground than with our 100 ft. stations. Thus this system develops an elasticity and adaptability to different grounds and circumstances which our foot arrangement does not possess. I am so confident that the chord of 20 meters is the standard chord of the future that I have some month since commenced the computation of, and now have well under way, a table of radii, log. of radii, etc., on that basis. Now a few words on the construction of the 20-meter chain. I would make the links two-tenths of a meter long, i. e., five links per meter and one hundred links to the chain. Designate each even-numbered meter by an oval-shaped brass tag, with the number of the meter counting from the forward end of the chain stamped in it, or rather stamped out of it, after the fashion of a stencil plate, in order to be easily read after dragging in the mud. The figures should be about 1 cm. (⅜ in.) high. The tags should be so attached to the chain that their planes will be at right angles to the length of the chain when it is suspended, in order that the figures may be conveniently read. Each odd numbered meter should be designated by a simple pointed tag so as to readily catch the eye. With this arrangement we should have no more mistakes in distance such as occur when the blundering chainman reads 40 for 60 and 30 for 70 on our 100-ft. chain of the usual form. Well, sir, I hope to see the discussion of a "standard chord" carried on till the best possible standard is arrived at and adopted and all other chords dropped out of practice.

Harry E. Blake,
Eng. Corps No. 1 Troy & Chatham Ry.

◆

GALVESTON HARBOR.

From a communication by H. C. Ripley, U. S. Assistant Engineer to the Texas *Journal of Commerce*, we take the following items:

The tidal basin which includes Galveston Bay, East Bay and a portion of West Bay, embraces 451 square miles. This basin is connected with the Gulf by a narrow passage, the width of which at mean low tide is about two miles and has an area of discharge of 155,000 sq. ft. The waters of the Gulf in entering this basin find passage after passing the gorge through two main channels, known respectively as Bolivar and Galveston channels. The former lies nearly east and west, curving slightly to the north at its western end. The latter has the form of a reversed curve, and lies northeast and southwest, its gulf end curving to the east as it enters Bolivar channel, and its bay end curving to the west. These two channels form the harbor proper. Bolivar channel has a length of 6 miles and average width of one-half mile, where the depth exceeds 18 ft. and reaches a maximum depth of 57 ft. Galveston channel has a length of 4 miles and average width of 650 ft., with a central depth ranging from 25 to 37 ft., except at the inner bar, where there is a least depth of 20 ft. The total area of the harbor is therefore 3½ square miles, and allowing a space of 500 ft. square for each vessel, would furnish anchorage for nearly 400 vessels.

The only obstruction to this magnificent harbor is the outer bar, which extends in the form of a semi-circle in front of Bolivar channel, and having upon its crest a natural depth of 12 ft. at mean low tide. The length of the bar measured along its crest is about 10 miles, and its width in front of Bolivar channel, measured from 18 ft. depth inside to 18 ft. depth outside, is 6,000 ft., and its distance from the gorge is about 4 miles. This bar is composed of fine sand to a depth of 60 ft. and is held in a condition, so to speak, of unstable equilibrium by two opposing forces, one of which is the ebb currents tending to push it gulfward, and the other the flood currents and sea tending to push it in upon the gorge. The plan of improvement is designed to destroy the equilibrium now existing, and by concentrating the ebb currents in a single channel across the bar enable them to scour and maintain a deep channel through it.

This plan contemplates the building of two jetties across the bar, slightly converging as they advance, making the distance between their sea ends about the same as the width of the gorge. The south jetty extends from Fort Point in a nearly east direction, and will have, when completed, a length of 22,000 ft. The north jetty will extend from a point about 2 miles from the Bolivar shore, in an east southeast direction, and will have a length of 8,000 ft.

It is due to Col. S. M. Mansfield, the United States Engineer officer in charge of the improvement of rivers and harbors on the coast of Texas, the inauguration here of a system of construction which has been eminently successful in similar works in Europe, but which, until quite recently, had never been attempted on this continent. This consists briefly of a combination of brush and stone in alternate courses. The lower or foundation course is very broad, varying with the height of the jetty, and successive courses are narrowed by degrees until the required height is reached. The construction of the south jetty was commenced about one year ago, and up to the present time the foundation course of the outer 3 miles is completed, with the exception of 700 ft. at the outer end and 3,000 ft. to be widened from 60 to 120 ft. The estimated quantity of material for the completed jetty is 253,000 cubic yards. Of this amount 113,000 cubic yards have been constructed, leaving 140,000 cubic yards remaining. It will thus be seen that nearly one-half of the bulk of the jetty is already constructed, and by the time the present appropriation is exhausted more than one-half of the entire bulk of the south jetty will have been completed. But it must be remembered that on account of the necessarily great width of the foundation course, while we have one-half of the bulk of the jetty constructed, we have but one-fifth of its proposed height, and hence the effect must be small compared to the effect which will be produced by the completed jetty.

Congress has appropriated and there has been expended for the improvement of this harbor to June 30, 1880, $618,413.75, which has resulted in increasing the depth on the inner bar to 20 ft., where the depth was but 11 ft. There has been expended upon the south jetty, for all purposes, to June 30, 1881, $194,776.84, and since that time about $175,000; and there are still remaining unexpended about $100,000.

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CAPT. EADS' SHIP RAILWAY.

The objections to Capt. Eads' ship railway are recapitulated by William L. Merry in a letter to the San Francisco *Argonaut*. In the first place, the scheme requires a specially solid road-bed, as well as a very wide one, and swamps and tropical rains at Tehuantepec make it impossible to build such a thing. Then, as the immense cars will require a perfectly straight track, there must at every change of direction and at every switch be an arrangement like a turn-table, and at every change of grade a tilting-table. These machines will be very expensive to build and maintain, and must be pretty numerous. Again, there is the obvious danger in handling loaded ships, the difficulty of building "cradles" to support them properly, and the chance that, in a high wind, they may be blown over. It is also to be considered that the tendency is constantly toward building larger vessels, and the railway, to equal a canal, must be able to handle anything that a canal could pass. And the great objection of all is that the scheme is untried, so that it would necessarily be, in a sense, an experiment, let engineers say what they will.—*Springfield Republican.*

Captain Eads writes to the New York *Herald* saying, among other things: "If I live five years longer I shall transport the largest loaded vessels from sea to sea across the Isthmus of Tehuantepec whether the United States contributes one nickel in aid of the enterprise or not. To do this it is not necessary that I shall alienate, mortgage or transfer to the United States or any other government any right granted by Mexico, nor do I expect to take the United States or any other government into partnership with me. I have no intention of appealing to the British Government for aid in this matter. Should an American or a British board of directors of the company, when it is organized, choose to appeal to the British Government for the assistance which is asked of the United States, it will have the right to do so, and to receive such aid under the terms of the concession, without forfeiting a single right which Mexico has granted, if the United States shall have then declined my proposition. It is proper for my countrymen to understand distinctly that my grant is from an independent nation, and not from one of the Central American republics, which are under the protectorate or suzerainty of the United States, and which are included in the terms of the Clayton-Bulwer treaty."

[This is a very commendable action on the part of the plucky captain, and it is to be hoped that he will give his British associates a chance to monopolize the Tehuantepec route. The United States Congress should be made to see how much it is throwing away by its recent action.]

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HOW CARS ARE HEATED IN ITALY.

The railroads from Venice to Susa (at the foot of Mount Cenis), through Lombardy, Sardinia and Piedmont, are of superior construction and the cars are exact imitations of the American, say, without compartments, and, of course, dissimilar from the cars on the French railroads. These Italian railroad cars are without stoves, or fuel of any description, but are most genially and delightfully warmed by portable, semi-flattened metallic cylinders, each of about three feet in length, filled with hot water, and as they gradually cool, en route, they are changed for those which are warmer, at the several stopping places or depots. The warm water in these semi-flattened metallic cylinders is secured from leakage, etc., by screw orifices, and is of a temperature adapted to the warming but not burning the feet put upon them.—*Boston Traveller.*

ENGINEERING NEWS.

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JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR .... ASSOCIATE EDITOR.

SATURDAY, FEB. 11, 1882.

EDITORIAL ANNOUNCEMENTS.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The regular fortnightly meeting of the American Society of Civil Engineers will be held on the evening of Wednesday, Feb. 15.

AMERICAN INSTITUTE OF MINING ENGINEERS.—Annual meeting, Washington, D. C., Feb. 21, 1882. Local Committee of Arrangements—Major J. W. Powell, Chairman; J. E. Hilgard, S. F. Emmons, A. S. Hewitt, F. W. Taylor. F. P. Dewey, Secretary.

Programme.—Tuesday, Feb. 21.—First session at 7 o'clock p. m. Addresses will be made by Hon. N. P. Hill on behalf of the Regents of the Smithsonian Institution, and by Major J. W. Powell, Director of the U. S. Geological Survey and Chairman of the Local Committee of Arrangements. At the conclusion of this session Major and Mrs. Powell will hold a reception for the members of the Institute and ladies accompanying them.

Wednesday, Feb 22.—Morning session at 10 o'clock for the reading and discussion of papers. In the afternoon, at 3 o'clock, there will be a special session in memory of Alexander Lyman Holley. The evening session, at 7:30, will be devoted to papers and discussions on iron and steel as structural materials.

Thursday, Feb 23.—Morning session at 10 o'clock for the reading and discussion of papers. In the afternoon an opportunity will be afforded members to visit the White House and the Treasury building. There will be a subscription dinner at Wormley's in the evening.

Friday, Feb. 24.—Morning session at 10 o'clock for the reading and discussion of papers and for the transaction of necessary business. In the afternoon a visit will be made to the Bureau of Printing and Engraving.

All the sessions of the Institute will be held in the National Museum building.

Hotel rates have been arranged as follows: Arlington, $4.00; Willard's, $4.00; Metropolitan, $3.00. There are also hotels on the European plan, of which the St. James is recommended. The Arlington Hotel will be the headquarters of the Institute. Members are recommended to secure rooms in advance, by writing directly to the hotels.

The Pennsylvania Railroad will sell excursion tickets to Washington from Pittsburgh and points on the main line, and from Boston, New York, Trenton and Philadelphia. These tickets can only be bought on the presentation of card orders which are distributed, on application of members, by the Secretary of the Institute. The excursion rates will be:

From	New York	$9.50
"	Trenton	7.10
"	Philadelphia	6.00
"	Pittsburgh	13.50
"	Johnstown	12 08
"	Harrisburg	5.27

The Baltimore & Ohio Railroad will also sell excursion tickets from Pittsburgh, on card orders, at thirteen dollars and fifty cents ($13.50). Members must be particular to specify which road they wish to take from Pittsburgh. Those desiring rates from other points on the B. & O. R. R. will please notify the Secretary at once.

Members are earnestly requested to notify Secretary as soon as they can of their intention to be present at the meeting, and mention the number of ladies who will accompany them.

The list of papers to be read will be ready for distribution at the meeting.
THOMAS M. DROWN, Sec'y.
EASTON, PA., Feb. 4, 1872.

WE would call attention to the very lucid paper of Mr. Ashbel Welch, President of the American Society of Civil Engineers, read before the railroad convention in New York, Oct. 17, 1 66, as exhibiting the results of his experience and anticipating by some years the system of safety signals now found to offer the greatest known security to railroad travel, and the introduction of which has heretofore been credited to others. The suggestions of Mr Welch, which are a manifest improvement over the ordinary block system, will be found not only to cover the best form of the latter in use on the English roads, but goes beyond them in providing, if carried out on the principle which he suggests, a degree of security from the possible carelessness or inefficiency of trainmen or station attendants, which had not previously entered sufficiently into the calculation of the road managers. If the spirit of these suggestions had been in force in the running regulations of the Hudson River Railroad, such a loss of life as that which occurred lately at Spuyten Duyvil could not have happened. Like everything emanating from Mr. Welch, these suggestions evince a thoughtfulness and attention to minutiae as well as a breadth of treatment which peculiarly qualify him as an adviser in such important matters.

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OUR ENGINEERING SOCIETIES.

In 1838 the Louisville, Cincinnati & Charleston Railroad Company purchased the Charleston & Hamburgh Railroad, then completed from Charleston to Hamburgh, a distance of 136 miles, contemplating a wide connection through Augusta, Ga., opposite Hamburgh, on the Savannah River, with roads completed and projected north and south from that point. The prominence of the works in that neighborhood will account for the presence at that date, in Augusta, Ga., of a large number of civil engineers of some prominence in their profession. Appreciating the value of unity of action among members of a profession whose labors even then embraced a wide area of territory, and having in view the value of association, as shown by the position then held by members of the British Institution of Civil Engineers, these gentlemen, at a meeting held in Augusta, issued a call for a convention of civil engineers of the United States, to be held in Baltimore on the 11th of February, 1839. The convention met on the day named, there being 40 gentlemen present, representing 11 States of the Union, and they appointed 17 engineers from different States as delegates to meet in Philadelphia on a day named in the succeeding month of April for the purpose of forming a constitution and to organize the society; and in the meanwhile the convention appointed five of their number to frame an address to the civil engineers of the United States explaining the object and importance, both to the members and to the public at large, of such an association as was proposed, and asking their co-operation. A copy of this address is now before us. Of the five members of this committee three are still living, two of them in the practice of their profession, and the third, although retired from active life, still interesting himself in works of internal improvements. To illustrate the influence of individual prestige at that date, it will be sufficient to state that, notwithstanding the enthusiasm shown by the profession at large, as evinced by the number attending the convention, and the unanimity exhibited in their proceedings, yet a single individual member of the profession, occupying at that day a very prominent position, passing through Baltimore at the time, and failing to receive what he considered as a proper consideration on the part of the convention, "allowed" the enthusiasm which was apparent throughout the proceedings of the convention to die out, and nothing farther was done toward perfecting the organization.

Subsequently, in 184- —the precise year has escaped us—an attempt was made in Albany, under the auspices of the late Charles B. Stuart, at the time, we believe, State Engineer of New York, to organize an Institution of Civil Engineers in the United States. This advanced so far as the issuing of an address to members of the profession, reciting the mutual advantages to be derived from such an association, etc.; but, like the first, it failed of receiving the anticipated response from the profession, and nothing more was heard of it.

In 1848 the Boston Society of Civil Engineers was formed, which owed its early success probably to its founders being less ambitious than those which had preceded it; and although the object of the Association was sufficiently broad to embrace among its members residents of other States than Massachusetts, yet it neither claimed nor aimed at a national character, and as a local society, is now highly respectable and successful; but no provision was made for the regular dissemination of professional information through published proceedings.

In the fall of 1852 the American Society of Civil Engineers and Architects was organized in New York, and was incorporated under that name, but subsequently the title was changed by dropping the word "architect," as the latter profession is represented by a flourishing association, having its headquarters in this city.

The founders of the American Society of Civil Engineers believed that a national society was called for, in the increasing importance to public interests that an assured standard for professional acquirement should exist, aside from the diplomas issued by the various technical schools and colleges of the country.

This society, after passing through the usual feebleness of most associations during their infancy, and the equally dangerous condition of youth, may be considered now as having emerged into the period of at least early manhood, and its future existence somewhat assured. From the first it has formed part of their system of management to issue a monthly publication of papers, with discussions growing out of them, selected by a committee of the society. The first object of this was to render the proceedings of the society of value to such of its members as were unable by distance or otherwise to participate in the full benefits of its meetings for discussion of professional topics. And that the purchase alone of these monthly publications by outsiders should not extend the benefits of membership beyond the walls of the institution, and thereby tend to weaken the value of a full-paid communion with the society, the latter decided to publish their own papers, copyrighted, and their circulation to be confined to the members of the society alone.

That the establishment of the society has been productive of great good is undoubted, not the least of these advantages being the multiplication of kindred societies, which the enormous extent of our country and the rapid increase of public works would seem to render necessary or desirable.

Notwithstanding, as we have shown, this society is not the oldest in the country, yet it may be regarded as the mother society, to whom all others are more or less under obligation and consider themselves as the off-shoots; and, so far as we are aware, none of the younger societies have entered the field with the intent to lessen the influence of the mother society, or to usurp a position for themselves which is rightfully hers; but in this utilitarian age, and with our people, a spirit of *progress* is an essential element of success, and no respect for moss-covered relics of antiquity will pervert the public judgment when in the pursuit of live issues; and this brings us to what we had to say, but were drawn off by a little bit of history, which itself suggests a volume of reflections upon the wonderful progress made in all branches of construction during the working life of men still living and working toward a great end, but with what increased facilities, and the mere recording of whose daily labors has called into existence, as a necessity of progress, a line of labor which was not dreamed of at that day as more than a mere embellishment to the everyday routine of work. But we forbear enlarging upon the progress of engineering works patent to all, and return to the matter of the professional associations growing out of them.

We have now nearly a dozen societies of civil engineers, fully organized and busy with the records of its members. Some of these publish their own proceedings for the use of their own members merely, and some are published by the *Journal of the Association of Engineering Societies* organized for the publication of the proceedings of such societies as elect to pursue that means of making their operations public. This method of publication may be expected to grow in favor, as a mode of reaching the public suited to the habits of our people and the wants of the day, which will no longer tolerate the narrow policy of a would-be close corporation; and the growing importance of these local societies, and the enterprise shown by the members in the endeavor to extend their usefulness by making individual experiences common property, indicates very clearly that there is but one course to be pursued by societies of engineers who aim in any sense to fill the public eye, and that is to make the contributions of their members, growing out of scientific investigations or practical experiences, attainable by the reading public at a price not disproportionate to their value. And no society of this kind, however respectable it may be in point of numbers or individual acquirement, can hope to occupy a commanding position unless by contributing to the advancement of sound scientific knowledge by opening the storehouses of their professional talent, and showing the grounds of their claim for precedence.

As something in the right direction, we would point to the proceedings of one of the younger societies, the November number of the "Proceedings of the Engineer's Club of Philadelphia," which we had promised ourselves to review for the benefit of our readers; but anything less than the republication of the entire number would be doing injustice to both, and we refer our readers to the publication itself as a model specimen in this branch of professional literature, and which our mother society would do well to ponder over and profit by, if she would not see herself stranded on the shore, whilst those who embarked at a later date sail by on a mid-channel current.

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BROOKLYN BRIDGE.

At the last regular meeting (see ENGINEERING NEWS, Jan. 14) of the trustees of the Brooklyn Bridge, a resolution was passed calling for an explanation from the Chief Engineer "of the *reduction* of 136 tons of steel from the quantity lately called for."

Anticipating something of interest in reference to changes of plan, we had a cross section of the bridge platform inserted in that number of the NEWS, showing in detail the present dimensions, and referring to the original plan of the elder Roebling.

The meeting of trustees took place on the 6th inst., and we give the Chief Engineer's explanation in answer to the resolution of the Board made a month since:

A REDUCTION OF ONE HUNDRED AND THIRTY-SIX TONS' WEIGHT.

Mr. Murphy read the following communication from the Chief Engineer:

"BROOKLYN, Feb. 6, 1882.

"*Hon. Henry C. Murphy, President Board of Trustees New York and Brooklyn Bridge:*

"DEAR SIR: The Board of Trustees, at their meeting on Monday, Jan. 9, resolved that the engineer be requested to inform the Board how a reduction of 136 tons in the weight of the additional steel required has become possible, and why such reduction was not made before the application was made for 200 tons additional. After the contract for the additional 200 tons was made I found it desirable to lighten the weight of the bridge. This required careful consideration, and took a long time to find out every place where a few pounds could be saved in weight without interfering with any any of the work already furnished. I only succeeded in saving 136 tons.

"Yours respectfully, W. A. ROEBLING."

A report from the Chief Engineer was read, recommending spruce as a covering for the track in lieu of oak or yellow pine, as previously proposed. The reason for this change, as explained by Mr. Stranahan, being a saving in weight of 130 tons! Sure that can scarcely be the reason for such change. If it be, is it not rather late to find it out?

The subject of the method of operating the bridge, having been under advisement since November, 1880, was reported upon by the Chief Engineer, as follows:

"BROOKLYN, Feb. 3, 1882.

"*Hon. Henry C. Murphy, President Board of Trustees New York and Brooklyn Bridge:*

"DEAR SIR: I am in receipt of your letter of 31st January, requesting me to communicate to your Committee on Transit my views relative to the comparative capacity, efficiency and economy of the two systems of running passenger trains, the alternating and circulating systems as they are called, and more particularly which of the two systems is preferable.

"In a letter which I wrote you on July 8 I gave my full approval to the plans prepared by Col. Paine for elevated platforms at the approaches of the bridge. If the Board of Trustees decide to elevate the termini I prefer the circulating to the alternating system.

"You will see, by referring to my reports of March 4 and April 5, 1878, that the reasons I gave for preferring the alternating system were based upon the assumption that trains would be run on the regular grade of the bridge. I then indicated how a change could be easily and quickly made to the circulating system if, after a short experience with the alternating system, such a change should be thought desirable. A serious objection to using the circulating system at the regular grade of the bridge is that the necessary switches and crossings required would seriously interfere with pedestrians crossing the bridge, actually dangerous for them, as the central sidewalk would be cut off at the crossings. The alternating system seemed to be the only one that could be safely operated on the regular bridge grade. By placing the tracks, necessary switchings, crossings on an elevated platform we can safely use a circulating system, and also provide a connection with the tracks of the elevated railways if it should be thought desirable at any future time to do so. It will be seen by the estimates I submit herewith that in the cost of motive power, etc., there will be a saving in the adoption of the circulating system of $4,887.30 over that of the alternative, but the cost of operating the circulating system will be but little over one-half as much as the alternating system.

"Very respectfully yours,

"W. A. ROEBLING, Chief Engineer."

The estimated cost of this has been $260,000. It is now put at $500,000, to which the trustees recommend that $100,000 be added, making a total of $600,000.

Mr. Barnes said he would like to know the reason the two estimates differed so widely. He moved that the Chief Engineer be requested to furnish an account of the plan upon which the first estimate was based. If the cheaper plans could be used it would be a great saving. He wanted the figures exact, for he did not want to go to the Legislature next winter asking for more money to complete the work.

Mr. Murphy said that was the object of the committee. They wanted the exact figures when they voted on the proposed plans.

We commend Mr. Murphy's anxiety that the *precise* figures should be given. If by any process in the power of the management of this work the precise cost of the structure could be arrived at, and, at the same time, what is of more importance to the impatient public to know, viz., the time *when* this consummation, so devoutly to be wished, can be anticipated with a reasonable degree of certainty, it would set at rest a great deal of idle speculation, and deep-seated skepticism. But neither of these questions appear to trouble the trustees at all; in fact, their individual effort to obtain any information, or to agree as to its precise significance, appear to be constantly baffled by an element of cross-purposes between engineers and trustees, which can only be settled satisfactorily, as we suggested some time since, by investigations carried on less at arms-length. There appears at all these meetings of the trustees an atmosphere of doubt and uncertainty pervading them, which has naturally extended to the public mind as involving a possible wrong-doing by some one, which interested parties are endeavoring to gloss over. We do not believe this; but that there is a lack of unity in the management and a great deal of misapprehension between individuals is evident; and if the trustees themselves are unable to get at the bottom facts, as appears to be the case, our outside position precludes us from anything beyond speculation or surmise, which it would be neither profitable nor pleasant for us to indulge in.

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PERSONAL.

There having been some rumors and whispered hints of irregularities in the administration of the Engineer Department of the City Government of Louisville, Ky., the City Engineer, R. T. Scowden, called for an investigation into the methods and practices of his office as administered by him. A committee of five, consisting of professional men and business experts was appointed, who, after two weeks' labor, rendered their several reports in detail to the Joint Finance Committee of the General City Council on the 1st inst. These reports all concur in bearing evidence to the skill and faithfulness exhibited by the Engineer, Mr. Scowden, and exonerate him completely from any wrong doing, and bear evidence to the faithfulness and thorough business qualifications shown by him in the administration of the duties of his office of City Engineer.

Referring to the great success of the enterprise of the Albany and Greenbush bridge, the Albany *Evening Journal* of the 31st ult. remarks: "The rapidity with which the practical part of the work has been accomplished is largely due to the energy and capability of Mr. C. L. Cooke, the engineer in charge, and his corps of competent assistants. Mr. Cooke came to the work with a reputation for exactness well established, and the nicety with which every detail connected with the construction of the bridge has fallen into position must certainly be placed to his credit in any piece of engineering he may hereafter have charge of. Mr. A. P. Boller, of New York, has as chief engineer of the new bridge been the 'master mind' in the work, but the details as arranged by him have been faithfully carried out by Mr. Cooke, who will act as Superintendent of the bridge until it is completed." Mr. Boller is a prominent expert on bridge building, and his very popular book on "Iron Highway Bridges" should be owned and studied by every engineer and highway commissioner who may ever have occasion to construct, or contract for, a bridge.

GEN. WALTER GWYNN, of Richmond Va., the oldest graduate of West Point, died at the Carrollton Hotel, Baltimore, last Monday morning. Gen. Gwynn was born in Jefferson County, Va., in 1802, and was consequently in the 80th year of his age. After receiving the ordinary common school education of his day, he entered West Point, where he graduated in 1822. He was appointed Lieutenant of Engineers, and after serving ten years with distinction resigned in 1832 to accept a position as civil engineer on the Baltimore & Ohio Railroad. He was subsequently Chief Engineer of the James River and Kanawha Canal, and was distinguished as one of the leading civil engineers of the Southern States. He went from one large work to another, and was connected with all Southern engineering improvements in Virginia and the Carolinas. At the breaking out of the Rebellion he was appointed Brigadier General and Chief of the Engineer Corps of the Confederate army. He was active in the defense of Charleston, and to his efforts and advice the first fall of Fort Sumpter was due.

DAVID JONES, a well-known civil engineer, died at his residence near Titusville, Penna., last Monday morning. He was sent to this country by James McHenry, representing 2,000 stockholders of the Atlantic & Great Western Railroad Company, to engage in the construction of branch lines. He had been engaged for many years in the construction of water-works, gas-works and railroads, in England, Wales and this country. At the time of his death he was a retired farmer.

MR ED. BIGELOW has been elected city engineer of Pittsburgh, Pa.

THE CORRUGATED METAL COMPANY, of East Berlin, Conn. held its annual meeting on the 3d, and elected the following directors: S. C. Wilcox, Geo. Cooke, R. H. Meagley, John Towne, W. O. Douglass, Chas. M. Jarvis, and at a subsequent meeting the following officers were appointed: S. C. Wilcox, President; R. H. Meagley, Treas.; C. M. Jarvis, Chief-Engineer and Superintendent. A dividend of 8 per cent was declared, and the capital stock increased to $75,000.

MR. EMILE LOW, a well-known civil engineer of Pittsburgh, but now with the Mexican Central Railway, had a narrow escape from instant death on Jan. 5 last, while witnessing an experiment with a new explosive in the silver mines of Mellado, Mexico. The charge went off suddenly, killing one man and injuring another to such an extent that he died three days thereafter, suffering all the time intense agonies from his awful injuries. Seven others were wounded more or less. Mr. Low, who was standing within four feet of the blast when it exploded, was violently thrown on his back. He received a gash on his upper lip from a flying fragment, and which also slightly broke his cheekbone near the nose. He at once received the best medical aid, and at the last accounts was being tenderly cared for at the house of the Methodist minister in Guanajuato. Ere this he is no doubt able to be about again.

C. L. FREEMAN, Water Inspector of Washington, D. C., has resigned his position, to go to Henderson County, N. C., to make a better salary by putting in machinery for woolen and grain mills in Western North Carolina, where the water-power is being utilized.

MAJ. D. W. WASHBURN, one of the best known railroad engineers in the country, was killed on the 7th inst., in a railroad accident on the Missouri Pacific road. Major Washburn had been out in a hand car inspecting some tracklaying on the Missouri Pacific Extension, between Waco and Taylor. He had with him Mr. Stoll, the manager, and Mr. Painter, foreman of tracklaying. Mrs. Stoll, her little boy, and two negroes were also on the hand car. The party was returning to make Major Washburn's special car, when the construction train, with 19 cars loaded with steel rails, backed by an engine, ran into the hand car. The general orders have been to "tie up" the construction train after dark, and Major Washburn's party did not know of its approach. Mr. Stoll and his wife and Mr. Painter were killed instantly. Major Washburn and Stoll's little boy lived about four hours. D. W. Washburn was Chief Engineer of the Pacific Improvement Company, Chief Engineer of the International Construction Company and Chief Engineer of the Mexican Construction Company. He was, in short, at the head of the construction department of the Gould system in the Southwest. His headquarters had been at Fort Worth since the commencement of the Texas & Pacific Railroad from that point westward. They were to be established at Laredo on Monday next, from which point Major Washburn was to superintend the construction of the Gould line through Mexico. The subordinate attachés of his department are at Laredo now. Major Washburn was about 37 years old, and at the time of his death held the highest position in his line of service in the world. He was from Elmira, N. Y. He entered West Point as a cadet before the war, but joined the Fourth New York Heavy Artillery and served throughout the Rebellion, retiring as Brevet Major. When the present Vice-President Hayes, of the International & Great Northern Railroad, began the construction of that line in 1869, he sent for Major Washburn to superintend the work. He had been identified with the construction of railroads in Texas ever since. Mr. Stoll had been connected with the Texas & Pacific Construction Department for the past two years, and Mrs. Stoll was one of the ladies who drove the last silver spike, about two months ago, which connected the Texas & Pacific and Southern Pacific roads at Sierra Blanco, Tex. The remains of Major Washburn will be brought to New York.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 39.

CXC.—DELHI.

Delhi, New York, in lat. 42° 18′ N., long. 74° 52′ W., is on the west bank of the Delaware River. It was incorporated as a village in 1821. In 1872 water-works were built by a private company, taking the supply by gravity from a brook which enters the river near the town. The water shed of the brook is about five miles long, and quite high hills are on each side of the valley of the stream. A dam 160 ft. long and 14 ft. high forms a small pond, 90 ft. higher than the village. A gravel filter extends back through the pond from the dam. It is 8 ft. wide at top and 20 ft. at the bottom, with the slopes paved with stone. The water passing through the gravel is conducted to the village about 2,000 ft. by two 6-in. cast-iron pipes.

Distribution is by cast-iron pipe, a 6-in. main passing through the main street, with 3-in. pipe in the side streets. There are about 4 miles in use, with 30 fire hydrants, 12 gates and 170 taps. The town does not pay for use of hydrants.

The population in 1880 was 2,947. The consumption is not stated.

The capital stock of the company is $26,000, with no debt. The works cost $26,000. The expenses in 1880 were $100 and the receipts $2,000.

D. T. Arbuckle is Secretary and Treasurer of the company and James Middlemist the Superintendent.

CXCI.—ATCHISON.

Atchison, Kansas, in lat. 39° 34′ N., long. 95° 10′ W., is on the Missouri River, in the valley of White Clay Creek. The business part of the city near the river is 38 ft. above low water. Half a mile to the west the ground is 60 ft. above low water. The ground rises to the north and south to an elevation of 180 ft. each side in three-fourths of a mile.

Settled in 1854, it was incorporated as a city in 1858. Water-works were built in 1880 by a private company, after the plans of Thomas J. Whitman, C. E.

The supply is taken from the Missouri River and pumped by two direct-acting vertical outside plunger pumping engines, built by Cope & Maxwell, with steam cylinders of 24-in. diameter, and plungers of 14-in. diameter, all of 36-in. stroke. The pumps are 16 ft. above low water level. The river rises 27 ft. The water is lifted 224 ft. into a settling reservoir 50 by 145 ft. at bottom and 100 by 185 ft. at surface, and 13 ft. deep, with the bottom and sides puddled, then covered with 4 in. of broken stone, on which is laid a pavement of brick on edge in cement. The bottom slopes toward the centre and the south end, where a 12-in. outlet pipe enables the sediment to be discharged.

When the river is frozen the water is clear enough to use without settling. At other times it is allowed to settle from 8 to 12 hours and is then drawn into the distributing reservoir adjoining, the full water level of which is 1 ft. below low water level of the settling basin. It is 75 by 160 ft. at bottom, 145 by 220 ft. at top and 20 ft. deep.

Distribution is by gravity, through 4,000 ft. of 12-in. cast-iron pipe, from reservoir to centre of city, and 8 miles of cast-iron pipe of from 12 to 4-in. diameter, with 54 fire hydrants, 36 gates, 319 taps and 7 meters. The city pays $6,000 per year for the use of hydrants. Wrought-iron service pipe is used. The population in 1880 was 15,106. The consumption is not stated, the operation of the works having only begun in May, 1880. The capital stock of the company is $80,000. The works have cost $150,000. There is a bonded debt of $80,000, bearing 7 per cent. interest.

J. B. Quigley is the Superintendent.

CXCII.—AUBURN, MAINE.

Auburn, Maine, in lat. 44° 8′ N., long. 70° 15′ W., is on the Androscoggin River on a plain sloping 55 ft. upwards from the river to the west for about half a mile to a range of hills. Settled in 1786 it was incorporated as a city in 1869, in which year also water-works were built by a private company, after the plans of F. M. Jordan, taking the supply from Wilson Pond, a natural lake 118 ft. above the city and 3 miles north of it. The lake covers 5 square miles; has a very limited water shed beyond that; has a sandy bottom nearly level, and in general 30 to 35 ft. deep, but with several deep holes, one of which is 300 ft. in diameter and 119 ft. deep.

The water is conveyed from the pond in cast-iron pipe of 12-in. diameter for ¾ mile, then reduced to 10-in., and continuing into the city. From the end of the 12-in. pipe a branch leads to a pumping station at the north city line and the base of the hills, where a Worthington compound duplex pump was erected in 1881, taking water from the main, at 62 ft. below the pond, lifts it 173 ft. into a plate-iron tank 60 ft. in diameter and 18 ft. high, on Goff's Hill, 4,000 ft. from the river and 230 ft. above the city. This tank is ordinarily shut off from the city distribution. In case of fire, the connection is opened and fire pressure put on the mains. A check-valve on the supply pipe prevents back-flow into Wilson's Pond.

There are 9.1 miles of cast-iron distribution pipe of from 12-in. to 3-in. diameter, 1¾ miles being less than 6 in. There are 17 fire hydrants and 800 taps. Service pipes are of enameled and galvanized wrought iron. The population in 1880 was 9,600 and the daily consumption 800,000 gallons. The capital stock of the company is $150,000. The works are stated to have cost that sum. There is no bonded debt. The expenses in 1880 were $2,000 and the receipts $8,000. N. J. Jordan is Treasurer and Manager of the company.

CXCIII.—LEBANON.

Lebanon, Pennsylvania, in lat. 40° 20′ N., long. 76° 24′ W., is on Quittapahilla Creek, on slightly undulating ground in the Lebanon Valley, between the Blue Ridge and the Kittatinny Mountains.

Settled in 1750, it was incorporated as a borough in 1813. Water-works were built by the borough in 1872, after the plans of H. P. M. Birkinbine, C. E., and under the superintendence of Benjamin Lehmann and Simeon Guilford.

The supply is taken from springs in the South or Kittatinny Mountains, six miles from the town. The water is collected in a reservoir of 16 acres area, holding 25,000,000 gallons, formed by a dam 30 ft. high across a mountain ravine, and at an elevation of 80 ft. above the town. A gravel "catch dam" above the main dam filters the water to some extent before it enters the 16-in. cast-iron pipe, which conducts it to the town. Distribution is by cast-iron pipe, of which about 9 miles are laid, with 62 fire hydrants and 1,246 taps.

The population in 1880 was 8,787. The consumption is not given. The works cost $300,000. The bonded debt is $250,000, bearing interest at 7 per cent., which will mature on April 1, 1882, and be renewed at 4 per cent. Statistics of expenses and revenue are not furnished. The works are managed by a board of directors appointed by the borough council. H. M. Allwein is the Superintendent.

CXIV.—PUEBLO.

Pueblo, Colorado., in lat. 38° 16′ N., long. 104° 8′ W., at the junction of the Arkansas and Fontaine-qui-bouille rivers, is at the foot of the Rocky Mountains, on a rolling prairie and elevated table lands, which can only be cultivated by irrigation.

Settled in 1858, it was incorporated as a city in 1870. Water-works were built by the city in 1874, after the plans and under the superintendence of James A. Richardson, C. E., taking the supply from the Arkansas River, the water shed of which is the eastern slope of the Rocky Mountains for about 150 miles north and south. The water is conducted from the river into three settling basins holding 15,000,000 gallons, designed by Galen W. Pearsons, C. E.

From the basins, the water is conveyed 2,000 ft. to the pumping station in a 14-in. cast-iron pipe. Vitrified stoneware pipe was first used for this purpose, with unsatisfactory results. A 4-cylinder Holly steam engine with pumps of 6½-in. diameter and 21-in. stroke pumps directly into the mains. Two Holly rotary pumps aid in putting on fire pressure. The ordinary pressure maintained is 55 lbs., and the fire pressure is from 60 to 180 lbs.

Distribution is by cast-iron pipe, of which 8 miles of from 8-in. to 4-in. diameter are laid, with 75 fire hydrants, 28 gates and 465 taps. Galvanized iron pipe is principally used for services, and some lead pipe.

The population in 1880 was 3,517 and the daily consumption 367,000 gallons.

The works have cost $160,000 and the aggregate receipts to December, 1881, were $51,900. There is a bonded debt of $140,000 bearing 8 per cent. interest, which is paid from direct taxation on property.

The expenses in 1880 were $6,000 and the receipts $11,000.

C. J. Stetson is the Chief Engineer and Manager.

CXCV.—GLOVERSVILLE.

Gloversville, New York, in lat. 43° 3′ N., long. 74° 19′ W., is on Cayadutta Creek, with lofty hills in its vicinity. Settled in 1830, it was incorporated as a village in 1851.

Water-works were built by the village in 1877, after the plans of Peter Hogan, C. E., with C. W. Knight, C. E., as assistant. The supply is taken from mountain springs, the water of which is collected in three storage reservoirs. The poor-house reservoir holds 3,000,000 gallons, collected from springs, the minimum yield of which is 300,000 gallons per day. The middle reservoir holds 500,000 gallons, collected from springs of a minimum daily yield of 200,000 gallons. The Bleecker Brook reservoir, supplied from a small stream, holds 1,500,000 gallons. The three reservoirs are connected by 12-in. pipe. The poor-house reservoir is 250 ft. above the village and a mile and a half from it. The water is conveyed to the village and distributed through 9 miles of cast-iron pipe of from 12 to 4-in. diameter, with 70 fire hydrants, 62 gates and 500 taps. Service pipes are of wrought iron, some plain and some galvanized and a few of lead.

The population in 1880 was 7,400, and the daily consumption was estimated at 300,000 gallons.

The works cost to May 1, 1881, $83,272.20, and the receipts to that date were $7,906.87.

There is a bonded debt of $80,000 at 6 per cent. interest. The expenses in 1880 were $766, and the receipts $3,368.38.

The works are managed by the village trustees, acting as a Board of Water Commissioners, under a general law of the State of New York.

Eugene Shove was Superintendent in 1878 and 1879, Cyrus Stewart in 1880 and A. W. Berry in 1881.

CXCVI.—CARBONDALE.

Carbondale, Pennsylvania, in lat. 41° 35′ N., long. 75° 30′ W., on the Lackawanna River, is at the head of the Lackawanna Valley between the Moosic and Greenfield mountains.

Settled in 1828, it was incorporated as a city in 1851. Water-works were built by a private company in 1868. The supply is by gravity from a storage reservoir built by the Delaware & Hudson Canal Company on the headwaters of Racket Brook, about 2 miles from the city, formed by an earth dam, with timber bulkhead, across the bank.

From this pond the water is conveyed 6,000 ft. through a 14-in. wrought-iron and cement pipe to a reservoir built in earthwork, with 3 acres area and 8 ft. depth at 250 ft. above the city.

Distribution is chiefly by wrought-iron and cement pipe. For extensions and where it has been necessary to replace pipes which have failed, cast-iron pipe is used. There are in use 2 miles of pipe of from 10 to 3-in. diameter, with 30 fire hydrants, 10 gates and 290 taps. Service pipes are of galvanized iron.

The city pays $25 per year for each of 27 hydrants.

The population in 1880 was 7,614. The daily consumption is not known.

The paid-up capital stock of the company is $11,625. The works have cost $20,400, besides the reservoirs leased from the Canal Co. Further financial statements are not given.

L. Egerton is Secretary of the company, and J. B. Van Bergen the Superintendent.

CXCVII.—EAST LIVERPOOL.

East Liverpool, Ohio, in lat. 40° 41′ N., long. 81° 38′ W., is on the Ohio River, 44 miles from Pittsburgh. Settled about 1800, it was incorporated as a village in 1834. Water works were built by the town in 1879, after the plans of R. C. Philips, C. E., taking the supply from the Ohio River and lifting it 325 ft. by two Cope & Maxwell steam 10-in. plunger pumps, into a reservoir holding 2,500,000 gallons, 265 ft. above the city. There are arrangements also for pumping directly into the mains with a fire pressure of 160 lbs.

Distribution is by cast-iron pipe of 10 to 4-in. diameter; 6 miles are in use, with 75 fire hydrants, 100 gates, 700 taps and 3 meters. Lead service pipe is used.

The population in 1880 was 5,568 and the daily consumption 200,000 gallons.

The works have cost $40,000 and the receipts to January, 1882, were $16,000. The expenses of maintenance in 1881 were $5,000 and the revenues $7,000. The works are managed by three Trustees.

C. Metser is the Clerk and Superintendent.

CXCVIII.—LOUELLA.

Louella, Pennsylvania, is a suburban village on the Pennsylvania Railroad, 13 miles west of Philadelphia, and 400 ft. above that city. The village was laid out in 1869 as a summer resort, and the population varies from less than 1,000 in winter to three times that number in summer.

Water-works were built in 1869 by George W. Childs, the founder of the village, after the plans of Isaac S. Cassin, C. E., taking the supply from Ithan Creek and pumping it 90 ft. by a Worthington duplex engine into a reservoir of 600,000 gallons capacity, built in excavation and embankment 75 ft. above the village. Distribution is by cast-iron pipe, of which 2 miles are laid, of from 8 to 4 in. diameter, with 16 fire hydrants and 23 gates. Lead service pipes are used. The works cost $20,000, are operated by the owner, and water is supplied without cost to lessees and purchasers of property in the village. The consumption in 1880 was 40,000 gallons daily. Benjamin F. Shaw is the manager of the works.

CXCIX.—MARTINSBURG.

Martinsburg, West Virginia, in lat. 39° 28′ N., long. 77° 55′ W., is on a small tributary of the Potomac River in a rolling country. The town was laid out in 1732. Water-works were built by the city in 1873, taking the supply from springs and pumping directly into the mains by 4 Holly pumps of 7½-in. bore and 22-in. stroke, driven by water-power, with supplemental steam-power for low-water seasons and fires. There is also a rotary pump for fire pressure. The ordinary pressure maintained is 60 lbs. and the fire pressure 90 lbs.

Distribution is by 5 miles of wrought-iron and cement pipe of from 12 to 3-in. diameter, and 1½ miles of iron pipe of from 3 to 1¼-in. diameter, with 42 fire dydrants, 20 gates and 550 taps. Wrought-iron service pipe are used.

The population in 1880 was 6,384, and the daily consumption varies from 170,000 gallons in winter to 260,000 gallons in summer.

The works cost $85,000. There is a bonded debt of $90,000 at 5 per cent. The expenses of maintenance in 1880 were $1,200 and the receipts $2,300.

J. M. Shaffer is the Engineer and Superintendent.

(TO BE CONTINUED.)

Corrections.—Feb. 4, 1882, *Chicopee*—Read, W. C. McClallan is President. *Fitchburg*—7th line, for Phineas Ball, read Phinehas Ball.

In list of towns, Jan. 28, p. 29—Returns received show that there are no water-works in the following towns, inserted from Prince's list, viz.:

Pekin, Ill.; Kokomo, Ind.; Washington, Ind.; Mt. Pleasant, Ia.; Morganza, Md.; Plainfield, Mich.; Huntingdon, Pa.; Corry, Pa.; Sharon, Pa.; Janesville, Wis.; Sparta, Wis.; Susquehanna, N. Y.

The receipt of statistics as follows is acknowledged with thanks:

From Benjamin F. Shaw, Manager, statistics of the water-works of Louella, Pa.; from L. Egerton, Secretary, statistics and water rates or the water-works of Carbondale. Pa.; from H. M. Allwein, Superintendent, statistics of the water-works of Lebanon, Pa.; from Charles A. Van Duzer, Superintendent, statistics and water rates of the water-works of Gouverneur, N. Y.; from Edward S. Silliman, President and Superintendent, statistics of the water-works of Mahanoy City, Pa.; from Marshalt Mason, Superintendent, statistics of the water-works of St. Albans, Vt.; from C. J. Stetson, Chief Engineer and Manager, statistics of water-works of Pueblo, Col.; from J. B. Wood, Chief Burgess, statistics of the water rates of the water-works of West Chester, Pa.; from J. W. Hughes, Chairman Water Committee, statistics of the water-works of Blairsville, Pa.; from F. S. Sibley, Superintendent, statistics and water rates of the water-works of Ionia, Mich.; from J. M. Shaffer, Engineer and Superintendent, statistics of the water-works of Martinsburg, W. Va.; from Henry C. Risdon, Secretary, statistics of the water-works of Mt. Holly, N. J.; from A. J. Morrison, Mayor, statistics of the water-works of Marengo, Ia.; from O. A. Neff, President, statistics of the water-works of Slatington, Pa.; from L. Case, statistics and water rates of the water-works of Prairie du Chien, Wis.; from B. Webster, Superintendent, statistics and water rates of the works of Malone, N. Y.; from Horea J. Evans, Superintendent, statistics and water rates of the water-works of Ebensburg, Pa.; from William D. Curtis, Treasurer and Water Commissioner, statistics and water rates of the water-works of Lenox, Mass.

PELLETIER PAVEMENT.

The following correspondence between Hon. Alexander Mitchell of Milwaukee, and ex-Commissioner of Public Works Waller, of Chicago, explains itself:

MILWAUKEE, Jan. 26, 1882.

C. S. WALLER, ESQ., ex-Commissioner of Public Works, Chicago, Ill.:

DEAR SIR: I am informed that you have given some attention to the pavement blocks of the "Pelletier Pavement Company," and may be in a position to express an opinion as to their durability and economy in use.

It is but too evident that the desideratum, that of combined durability, healthfulness and cheapness, in pavements for the principal streets of our western cities, has not yet been reached. The experience had with the materials of stone, iron, asphalt and wood has proved, and is daily proving, unsatisfactory. But, notwithstanding the uniform failures attending the numerous and varied efforts in this direction, it is certainly not too much to hope, in this age of successful progress in every department of scientific investigation, that that desideratum may be found, and that our streets may yet be paved with a material pleasant in use and proportionately as lasting as the commodious structures with which they are now being adorned.

Feeling a deep interest in this subject, I shall esteem it a favor, therefore, if you will give me any information you may possess of the Pelletier blocks, founded on tests made by you or on your personal observation. I am, very truly, your obedient servant, ALEX. MITCHELL.

MR. WALLER'S REPLY.

CHICAGO, Feb. 1.

HON. ALEX. MITCHELL, Milwaukee, Wis.:

DEAR SIR: Yours of the 26th ult., on the subject of street-paving, and making inquiry as to the merits of the Pelletier blocks, is received.

As Commissioner of Public Works of this city during the last three years I have given much thought and attention to the subject of street-paving. A large amount of money has been paid out by our people from year to year for the improvement of our streets, with an earnest desire to have a clean and well-paved city; but, notwithstanding the long and patient submission to heavy taxation which they have borne for this purpose, the hope has not been realized. Our streets to-day are very unsatisfactory, and many of them are in a wretched condition—full of holes and breaks, which are the receptacles of filth, too dilapidated to admit of successful repair, and too much decayed and broken up to be cleaned by machine-sweeping. The truth is, our Chicago streets are, as some one said, "all the time giving out," and have to be replaced with new paving.

While the expense of such a system is very burdensome to the people there is no hope for relief, or of seeing our streets well and completely paved throughout until we adopt a material for paving that is imperishable and sufficiently hard and adhesive to stand the wear of heavy and continuous traffic. To get such a material at a moderate price is the great desideratum, the crying want and need of all our American cities, for the experience of them all is very similar to that of Chicago.

Wooden blocks of any sort for paving streets are a delusion and a snare, a luxury at first, but a complete failure in the end; very short-lived (the last half of which is simply abominable), while the continual renewals necessary are, in the aggregate, very expensive. Wooden blocks, when decaying, absorb all kinds of filth readily, and the exhalations from many miles of such streets in a crowded city are certainly unhealthy and pernicious, and should be avoided if possible. Good foundations are indispensable to having good streets; every time an old wooden pavement is removed, the débris of rotten wood, mingled with the original road-bed, makes it less substantial and firm. I could fill this letter with solid objections to the use of wooden blocks, taken from our experience in this city. I have said this much, however, and spoken thus strongly concerning this class of pavement, because it is the great evil which we have so long persisted in, and which is the manifest cause of the present deplorable condition of our streets. We have expended money freely—enormous sums for street-paving, but the result shows that we have done so unwisely. I agree with you exactly that "durability, healthfulness and cheapness" are the indispensable requirements in the coming street pavement to justify approval and to give general satisfaction. At present the burden of expense is oppressive, while the comfort realized is short-lived and meager, and therefore very unsatisfactory.

Granite blocks, every one knows, are clean, healthy and durable, all of which is desirable; but they cannot be got out in uniform shape, and, therefore, will not make a tight pavement; they grow slippery and turtle-backed by long use, and are quite noisy, and, above all, are too expensive. They cost here, when laid, from $1 to $4.50 per square yard.

Granite is difficult to work, and cannot be brought to that smoothness and exactness of line necessary to give uniformity of bearing on the sides, or evenness on the surface, without incurring an expense altogether too great, and which puts it out of the question. The noise from passing vehicles on a paved street is largely due to the irregularities of its surface; it is also true that a heavily-loaded truck or even a light vehicle is much more easily drawn over a comparatively smooth surface than a rough one, while the inevitable friction and jar occasioned by the latter, of course, tend to wear out more rapidly both the street and the vehicles which pass over it. There is a metallic ring or prolonged echo from granite blocks which adds to the volume of sound from a street thus paved when crowded with passing vehicles, but with blocks made of crushed and compressed stone this continuity of sound is broken up, and, as a consequence, the noise therefrom is to a large extent avoided.

The Medina sandstone makes a fair pavement in some respects; it is clean and healthy, and not slippery, but the blocks are not of uniform size, many of them being too thin; sufficient compactness is not attainable, and the water runs through to the foundation, instead of off the street. The cost of this kind of pavement here is from $3 to $3.50 per square yard.

Limestone macadam does very well for a foundation, but will not answer for the surface of a street where there is heavy traffic. The material is too soft, absorbs water freely, slacks and softens under the action of frost, and cuts away rapidly under the grinding wear of heavily-loaded vehicles. We all know what a limestone turnpike is for dust and mud.

The limestone asphalt block, made from limestone, with from 10 to 15 per cent. of asphalt in it, has, to a very considerable extent, the same objections which apply to limestone macadam. It is too soft for durability under severe usage, and I have no faith in the continued and permanent adhesiveness of the asphalt put into it which is relied upon to bind and hold it together. Limestone in its natural state presents too soft a surface to resist the incessant wear and grinding, pulverizing effect of the many passing wheels on a busy street. To crush it and then compress it into block does not increase its hardness nor make it equal to what it was in its natural state. To mix it with asphalt does not harden or help it in this regard. In my opinion this block has not the hardness necessary to give it durability. The original substance (limestone) being known to be too soft, and as nothing is added to it which remedies this, and as the process which it undergoes in being manufactured into blocks necessarily tends to soften it still more, I can see no just ground for hope in its durability. I have seen it tried here along with granite blocks and the Pelletier blocks, under a severe and exactly equal test, and it wore away to the depth of three-quarters of an inch, while the granite and Pelletiers were scarcely touched under precisely the same usage. This much in regard to the several kinds of material for such pavements which we have used here, with the objections to each briefly noted. I now come to the special object of your inquiry—to-wit, the Pelletier paving blocks. I have given these blocks much attention, have seen them made, have noted carefully all the material used, and the whole process of making them, have seen them submitted to severe practical tests, and am, therefore, prepared to speak understandingly concerning them. They are firm, clean, handsome, durable, healthful and cheap. They can be furnished to contractors at about $1.50 per square yard, and be laid complete in a street at an entire cost of about $2 per square yard. These blocks are made of hard, durable stone, crushed, thoroughly dried, mixed with 10 per cent. of iron slag or a low grade of iron ore, and subjected to a thorough infusion of a chemical combination of oxide and chloride of iron, which acts as a perpetual binder, growing harder and firmer, more granite-like, with age and exposure to the weather and seasons. In manufacture they are subject to great compression, which renders them very dense and compact, absolutely impervious to water. The blocks are even in surface and symmetrical, with slightly beveled edges, giving a good and sufficient foothold for horses. Being uniform in shape and exactly true in line, they can be laid on the street with such compactness as to form almost impervious joints, thus shedding the water from the street and protecting the road-bed and foundation, which is very desirable. And being laid thus compactly from curb to curb across the crown of the street gives a flattened arch which with its uniform lateral pressure greatly assists the foundation in keeping the pavement intact, and free from sinks and depressions of any sort. These blocks, when freshly made, have been subjected to the extremes of heat and cold, which seemed only to season and harden them rapidly.

I have seen the following severe test applied to them: Fixed rigidly in an iron box, with granite and other blocks by the side of them, and in the same test for comparison, presenting an exactly even surface at the start; then heavy iron wheels (shod with the ordinary width of tires) were passed over them, propelled by machinery, and running in a circle of 8 ft. in diameter, which made the test, you will observe, much more severe than if running in a straight line, because of the steady impingement of the wheels upon the inner line of the track. The first ten hours the wheels were run with weight equal to a truck weighing 8,112 pounds, passing over the blocks in exactly the same track 16,800 times; then an additional run of four and a quarter hours was made with weight equal to a truck weighing 10,632 pounds, passing over the blocks in the same track 8,500 times more. Weight on each wheel first ten hours, 2,028 pounds; last four and a quarter hours, 2,658 pounds.

After this severe test the Pelletier blocks showed but little, if any, more wear than the granite, the abrasions upon each being very slight.

The Pelletier blocks kept a comparatively rough surface, not glazed or slippery like the granite. From this practical and severe test I am satisfied that the Pelletier blocks will stand the wear of any of our streets. Now, in the matter we are considering, hardness, permanent adhesiveness and imperishableness are the essential qualities necessary to give durability; cleanliness and healthfulness, being thus subserved, naturally follow, and with these several qualities combined and the whole obtainable at a moderate price, we have the desideratum so widely sought for—to wit, a satisfactory street pavement. The Pelletier blocks, in my opinion (based upon the reasons herein given) will meet and fill all these requirements.

I have received letters of inquiry concerning these blocks from a number of surrounding States. The demand for them, as soon as they can be supplied, bids fair to be very great. Chicago alone will need a vast quantity.

Your letter found me on a sick bed, and I have not been well enough to answer it until to-day. Trusting that I have covered sufficiently the several points of your inquiry, I am, respectfully,

Yours, CHARLES S. WALLER.

—*Milwaukee Republican, Feb.* 4, 1882.

LITERATURE.

History of the St. Louis Bridge.—By C. E. WOODWARD, Prof. Math. and Appld. Mech., Washington University, St. Louis, Mo., 1881. C. I. Jones & Co., St. Louis.

It is so seldom that we have a full and reliable history of any of the numerous important engineering works executed in this country that we are especially gratified to draw attention to so thorough and well digested an account of the inception, progress and completion of the St. Louis bridge as the above book furnishes. Usually at the completion of works of this character, the owners are more interested in the future management and revenue, than in the history of what is often a bitter and costly experiment. The engineers are desirous and ambitious for new fields of labor, and cannot afford the time, nor too often the money, to put before the public a record of their past achievements.

But for the care and forethought of the Chief Engineer of the St. Louis bridge, the above reasons might have operated to deprive us of a history of this work. From the commencement of actual work, however, all his assistants were instructed to keep full daily logs of all the operations immediately under their control, and these, together with the official records and correspondence, formed an immense store of reliable data from which a careful historian could evolve the true story of the difficulties and problems constantly demanding investigation and solution.

Judging from the work before us, Capt. Eads found such a historian in Prof. C. M. Woodward, the difficulties of whose position can hardly be appreciated by those unacquainted with all the facts and disputed points. It was no easy task to digest carefully all the facts, problems and controverted points, and give a reliable and interesting account of the many trials, delays and difficulties, due not solely to the solution of new and untried engineering problems, but to financial troubles and disputed contracts without doing injustice or overburdening the volume with testimony.

The author in the preface remarks: "The building of this bridge was attended with controversies more or less sharp, and striking differences of opinion. I have endeavored to deal with all such in an impartial and judicious manner * * *. In some instances I have differed from personal friends with whom I would gladly agree * * *. If I have wrongly stated the position of any party on any point, I am very sorry. I have generally relied on documentary proof."

From the mass of evidence, he has made a very clear and readable account of this work from its first inception to the final testing of the completed structure, quoting very fully from original documents.

The book opens with a clear and concise account of the basin and regimen of the Mississippi River; a sketch of the attempts to bridge the river at St. Louis; the organization and consolidation of the rival companies. This occupies only 31 pages of the volume. The remaining chapters treat very fully of the sinking of the three great piers by compressed air and the coffer-dam work of the west abutment: the contracts and specifications; the manufacture of the steel and iron; the workmanship of the several elements of the arch; the erection of the arches and superstructure; the closing of the spans; the physiological effects of compressed air; the strength and elasticity of materials; the theory of the ribbed arch; numerical calculations and stability of the foundations; tabular statements of the dimensions and quantities of material—iron, steel, wood and masonry; engineering cost of the several classes of work upon the piers and superstructure, and various other points of interest, not only to the engineer, but to every one interested in scientific problems and the practical solution of difficult questions in the manufacture and mechanical manipulation of materials.

It would be difficult to say which part of the book does not contain facts and opinions of great interest, especially to every engineer. The pages devoted to the founding of piers to such great depths will always be a mine from which to gather facts and experience for all interested in compressed air work.

The solution of the problem of erection by the methods of cables and closing of the spans—a simple matter after it was accomplished, but, at the time, looked upon with doubt and much croaking by some of our most experienced engineers—cannot fail to be of interest.

The book would not be complete without the carefully and clearly-written chapters upon the analytical investigation of the ribbed arch.

The chapters upon contracts, controversies and specifications and the manufacture and testing of the materials are full of valuable matter and impress one with the forethought of the publisher in leaving a large blank space at the ends of these chapters for the reader to write the following or other "morales:"

1st.—He who makes a new design and specifications after the contract is made must expect to pay the piper.

2d.—He who attempts to use untried forms and pieces beyond the experience of our manufacturers and requiring the development of new plant must expect delays and failures.

The extracts from the numerous tests made upon the material and finished parts of this structure are very interesting and instructive.

The text is fully illustrated with wood-cuts, and the full details of the structure are given upon forty full-page lithographic plates of most excellent execution, the handiwork of Wm. P. Gerhard, C.E., now of Newport, R. I. In addition there are nine beautiful artotypes from photographs taken during the erection and after the completion of the bridge, and a fine steel engraving of the chief engineer, Jas. B. Eads. Apparently nothing has been overlooked to make this volume perfect in all its details, and its execution reflects great credit upon the publisher, C. I. Jones & Co., of St. Louis.

We can confidently recommend this volume as a valuable addition to every engineer's library, and believe any careful student will get a full return from its perusal, for the investment demanded—a sum not unreasonable for a book so well edited, executed and illustrated as the one before us.

We can well say of it "better late than never."

ACTION OF HYDRAULIC CEMENTS UPON IMBEDDED METALS.

John C. Trautwine, C. E., in a communication to the *Railroad Gazette* dated Philadelphia, Jan. 21, 1882, says: "The fact that this important subject has of late been brought somewhat prominently before the notice of civil engineers and builders induces me to send you the results of 10 years' trial by myself. The hydraulic cements used were English, Portland and Louisville, Kentucky, besides which I tried plaster of Paris, both pure and mixed, with equal measures of the cements. All were of about the consistency of common mortar; and all were kept in an upper room during the ten years, unexposed to moisture other than that of the indoor atmosphere.

The metals were partly embedded in the pastes and partly projecting from them. They consisted of cut iron nails (some of which were galvanized), smooth iron wire nails, brass in both sheet and wire, zinc in sheet, copper wire, and solid cylinders of lead ½ in. diameter.

The result at the end of ten years was that all the metals in both of the *neat* cements were *absolutely unchanged;* and the same was the case with those in the plaster of Paris, with the exception of the *ungalvanized* nails, which had become covered with a thin coat of rust; as were also those in the mixtures of plaster and cement, but to a less degree.

This experience leads to the inference (already suggested by others) that moisture or dampness is the injurious agent in those cases of corrosion of iron and lead laid in cement that have lately appeared in the journals; and that if dampness can be absolutely excluded, both cement and lime mortar will probably protect from injury all the metals employed in ordinary constructions, for an indefinite time.

Such entire exclusion of dampness may at times be somewhat difficult of attainment; for capillary attraction *alone* (unaided by hydrostatic pressure) will cause water to rise several inches in well-hardened cement; and it would be difficult to assign limits to its penetration when aided by a high head of water. Rain water is well known to percolate through many feet in depth of brick work or masonry laid in lime mortar, even when it consists partly of cement."

ADJUSTMENT OF GRADES TO CURVES.

The following communication from H. A. McClellan, Chief Engineer Nevada & Oregon Railroad, dated Reno, Nev., October, 1881, apeared in the *Railroad Gazette* of Dec. 2, 1881:

The question of the adjustment of grades to curves is one which has not yet received anything like the consideration which it deserves from all engineers who are laying out the lines of our railroads:

Mr. Wellington's book,* "The Economic Theory of the Location of Railways," is the only one of the kind I have ever heard of which treats of the subject in such a manner as to be of any real use to an engineer.

For the production of this admirable book Mr. Wellington deserves the gratitude of the engineers of the United States, and something more substantial than gratitude from railroad companies who are building new roads.

But this book, good as it is, is only an introduction to the subject; and as there have been no experiments made of a sufficiently extended character to fully determine how much reduction of grade is required to exactly compensate curve resistance, it is necessary to experiment and learn as fast as we can from experience.

A short account of what has been done on the Nevada & Oregon Railroad in this way may be of interest to others, and help them to start a little farther ahead in the subject than I was able to do. I will say in explanation that our road is of 3-ft. gauge. The limit of grades was fixed at 100 ft. per mile, and of curves at 18°. As we had to grade 10 miles before we had any iron to lay down, we had to build that much on faith, and test our theories afterward.

On page 184 of his book Mr. Wellington shows that the slight reduction for curves heretofore made by some roads was not enough to compensate the *limiting* resistance of curvature; so, as there was no precedent for *any* particular amount, we tried his suggestion of reducing 0.1' per degree for each 100 ft.

After grading 5 miles we became convinced that the resistance did not increase directly as the curvature, but that it was much less than the average on light curves, and much more on sharp ones. We then adopted a sliding scale, in which the reduction was only 0.02 ft. for a 1° curve, and increased in amount as the curve became sharper; so that for an 8° curve it amounted to 0.06 ft. per degree; and 18° curves were made level.

When the track was finally laid, and trains running, we found that our first reduction was a little too much, as the train would gain speed on all curves, without any more steam.

On the second 5 miles the reduction on curves of less than 8° appears to be about right, as there is no perceptible change of speed when running off a tangent on to a curve, or vice versa. But on curves sharper than 8° it is too much, as on the first 5 miles.

Since then I have worked out the following table. It is derived in part from a formula given as the result of experiments made by the Belgian government to determine the amount of curve resistance.

The formula is $R = \dfrac{0.6504}{\textit{Radius}-55.}$ in which the radius is in meters; and R is the coefficient of the curve resistance.

Table of Curve Resistance and Equivalent Grades on Straight Lines.

Curve.	Coefficient of resistance.	Resistance in pounds per ton.	Equivalent grade in feet per mile.	Equivalent grade in feet per 100 ft.
Tan	0.00000	0.0'	0.00	0.00
1°	0.00038	0.76	2.00	0.03
2°	0.00081	1.62	4.26	0.08
3°	0.00123	2.46	6.53	0.12
4°	0.00172	3.44	9.05	0.17
5°	0.00222	4.44	11.68	0.22
6°	0.00277	5.54	14.58	0.28
7°	0.00336	6.72	17.68	0.33
8°	0.00401	8.02	21.11	0.40
9°	0.00471	9.42	24.79	0.47
10°	0.00547	10.94	28.79	0.54
11°	0.00631	12.62	33.21	0.63
12°	0.00723	14.46	38.05	0.72
13°	0.00826	16.52	43.48	0.82
14°	0.00938	18.76	49.37	0.93
15°	0.01066	21.32	56.10	1.06
16°	0.01204	24.08	63.30	1.19
17°	0.01369	27.38	72.05	1.36
18°	0.01555	31.06	81.60	1.54
19°	0.01767	35.34	93.00	1.76
20°	0.02019	40.38	106.26	2.01

The second column gives the coefficient of resistance due to curvature for each degree of curve up to 20°. The amount of resistance per ton was obtained by multiplying 2,000 by this coefficient for each degree.

Column 4 shows the grade per mile on a straight line, which would give a resistance due to gravity equal to that due to curvature. To obtain it, the resistance per foot of rise was taken at 0.38 lbs. From this one, column 5 was deduced. It shows the amount of rise per station on a straight line, which would produce the same resistance as the given curve would produce on a level.

To use the table, the amounts in column 5 must be subtracted from the maximum grade on a tangent, and the result will give the amount of grade permissible on the several curves.

With any given maximum rate of grade on tangents, the table will show the maximum degree of curvature which ought to be used with it; for, of course no curve should be used in which the resistance due to curvature alone exceeds that due to gravity on a tangent.

As we have not yet laid any rails on that part of the line which was laid out in accordance with this table, I cannot tell how nearly correct it is, but the rates of grade given by it are almost exactly the same as those we used for curves of less than 8° on the second section. So I think it is a close approximation to the proper amount, and a safe basis for further experiments.

The following query from C. D. Ward, of Jersey City, appeared in a later issue of the same paper:

"Referring to the very valuable paper by H. G. McClellan, Chief Engineer N. & O. Railroad, on 'Adjustment of Grades to Curves,' in the *Gazette* of Dec. 2, I should like to ask where he begins and ends the grade reduction for curvature—whether exactly at the beginning and ending of the curve or at some point beyond them, as Mr. Wellington suggests.

"Also what reduction be would consider proper on a standard gauge road compared to his 3-ft. gauge."

◆

The metes and bounds of "Sockum," Del., are stated to be—"commencing at the State line at Whiteleysburg and running east until the line intersects the Felton road, thence west to the Maryland line." This reads like the description of an imaginary straight line, but "Sockum" is shaped like a flat-iron, with the point toward the Delaware Railroad.

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*This book is practically out of print, as Mr. Wellington has stated that he could not say when he would find the time to revise it for a new edition.—Ed. Eng. News.

CONTRACT AND SPECIFICATIONS FOR THE CONSTRUCTION OF THE SUPERSTRUCTURE OF THE YOUGHIOGHENY BRIDGE, McKEESPORT, PA.

GENERAL DESCRIPTION.

Attached to and combined with these specifications is a blue print giving a skeleton plan and profile of the bridge, and also sections of the different floor systems.

Alignment.—The alignment from the west abutment of the bridge to the center of Pier No. 2 is a ten (10) degree curve to the right; thence a tangent to the center of Pier No. 3; thence a five (5) degree curve to the right to the center of Pier No. 4, there compounding with a [illegible] degree curve to the right, said [illegible] terminating in a tangent point [illegible] before reaching the face of the east abutment, thence tangent. The alignment thus given is for the main line of the P., McK. & Y. R. R.

M. E. S. R. R.—On the west side, the Monongahela East Shore Railroad branches off to the right from the Pittsburgh, McKeesport & Youghiogheny Railroad with a ten (10) degree curve, beginning at the center of Pier No. 2, as shown.

Grades.—The grade from the west abutment to the center of Pier No. 3, is level; thence a descending grade of six (6) inches per hundred feet to the east abutment.

Spans Nos. 1 and 2.—Spans Nos. 1 and 2 are both on the ten (10) degree curve.

Span No. 1.—Span No. 1 measures ninety (90) feet on the chord from the face of the back wall of the west abutment to the center of Pier No. 1.

Span No. 2.—Span No. 2 measures ninety (90) feet on the chord from center of Pier No. 1 to center of Pier No. 2.

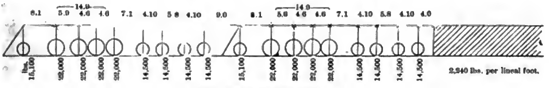


DIAGRAM SHOWING MOVING LOAD.

Span No. 3.—Span No. 3 measures two hundred and thirty-six (236) feet from center of Pier No. 2 to center of Pier No. 3.

Span No. 4.—Span No. 4 measures one hundred and thirty-seven (137) feet and six (6) inches on the chord of the five (5) degree curve from center of Pier No. 3 to center of Pier No. 4.

Span No. 5.—Span No. 5 measures one hundred and thirty-seven (137) feet and six (6) inches on the chord of the seven (7) degree curve from center of Pier No. 4 to center of East Shore Pier No. 5.

Span No. 6.—Span No. 6 measures sixty-eight (68) feet on the chord of the seven (7) degree curve from center of East Shore Pier No. 5 to center of next pier, No. 6.

Iron Trestle.—From end of span No. 6 to the east abutment, there are five spans of plate girders built on iron trestles, each span measured on the chord of the seven (7) degree curve. The first span is thirty-four (34) feet from center of pier No. 6 to first bent; then three (3) spans of thirty-two (32) feet each from center to center of bents; last span, thirty-six (36) feet from center of last bent to the back wall of the abutment, or thirty-two (32) feet and six (6) inches to the face of the abutment. By face of the abutment is meant the front of the wall under bridge seat coping, said coping projecting six (6) inches.

MASONRY.

West Abutment.—The west abutment has a bridge seat of five (5) feet, measured on the center line. The face of abutment is built askew to the tangent produced of span No. 3, at an angle of sixty-four (64) degrees.

Piers.—Piers 1, 2, 3 and 4 are built askew to tangent produced of span No. 3, at an angle of sixty (60) degrees; piers 5 and 6 at an angle of fifty-eight (58) degrees to the same line. All trestle piers built parallel to pier No. 6 and to the face of the east abutment.

Pier No. 1.—Pier No. 1 has a width of eight (8) feet on the top of the coping out to out, measured at right angles to axis of pier.

Piers Nos. 2 and 3.—Piers Nos. 2 and 3 are ten (10) feet wide on top of coping, at right angles to axis of pier.

Pier No. 4.—Pier No. 4 is nine (9) feet wide on top of coping, at right angles to axis of pier.

Pier No. 5.—Pier No. 5, or East Shore Pier, is seven (7) feet wide on top of coping, at right angles to axis of pier.

Pier No. 6.—Pier No. 6 is six (6) feet wide on top of coping, at right angles to axis of pier.

Trestle Footings.—Trestle footings will be composed of pedestal stones three (3) feet square, two (2) feet deep, having bases of five (5) feet square and two (2) feet deep, resting on a bed of concrete six (6) feet square and four (4) feet deep.

East Abutment.—East abutment, four (4) feet bridge seat.

Coping.—The coping projects over faces of walls in all cases, six (6) inches.

SPANS.

Spans 1 and 2.—Spans Nos. 1 and 2 are deck spans, having pin-connected trusses. Cross section trusses shown.

The floor beams to be iron plate girders, riveted to every post.

The stringers to be composed of packed I beams as shown; top of stringers level with top of chords.

Depth of Truss.—Depth of truss, ten (10) feet center to center of chords. Panels not over ten (10) feet long.

Depth of Floor Beams.—Depth of floor beams, eighteen (18) inches.

Depth of Stringers.—Depth of stringers, twelve (12) inches. The stringers to be composed of four twelve (12) inch light I beams, packed two together, as shown, and riveted to floor beams, the joints of the I beams to be broken and each I beam continuous for two panel lengths and joints spliced on both sides and well riveted.

Spans 1 and 2 to have top and bottom lateral bracing at each panel, with vibration rods at each panel point.

Ties.—Ties to be nine (9) inches wide with three (3) inches space between them, or twelve (12) inches from center to center, of best quality white oak, countersunk one-half (½) inch on top of stringers and top chord.

The bottom of ties to be level. The top of ties to be five and one-half (5½) inches above top of inside stringer and beveled out to out of chords sufficient to give one (1) inch elevation on outside rail. The full elevation to continue to the center of pier No. 2; then gradually decreasing to a point fifty (50) feet distant from pier No. 2, on span No. 3, where the rails are to be level. The center of track to be on the regular grade, the elevation to be obtained by raising the outside rail one-half (½) inch and depressing the inside rail one-half (½) inch.

Width of Truss.—Width between centers of trusses eleven (11) feet. The versed sine at the center of the span on the curve is about twenty-one (21) inches. The spans are to be so arranged as to have half of the versed sine taken up by the track at the center of the spans, and the other half at the ends of the spans. The parts of the trusses which receive the excess weight on account of the curve, to be increased in dimensions to allow for the increased weight of the moving load at those points.

Guards.—Guard rails to be placed at a distance of one (1) foot in the clear from the outside of the rails, composed of the best quality of white oak, eight (8) inches by six (6) inches in section; to be notched down one-half (½) inch on the ties and bolted to the top flanges of the floor beams with three-quarter (¾) inch bolts, and bolted twice through the ties between floor beams.

Gauge of Track.—The gauge of the track to be four (4) feet eight and three-quarters (8¾) inches on a tangent, and four (4) feet nine and three-quarters (9¾) inches on spans 1 and 2.

Span No. 2.—Span No. 2 shall be shown in two ways:

First, a detailed plan shall be shown for a single track for the P., McK. & Y. R. R.

Second, a detailed plan shall be shown of three trusses, so as to allow the connection of the M. E. S. R. R. with the P., McK. & Y. R. R., at the center of Pier No. 2, as shown in plan.

Span No. 3.—Span No. 3 measures two hundred and thirty-six (236) feet from center to center of Piers 2 and 3. The distance from inner edge of inclined end posts to center of track to be not less than seven (7) feet. The centers of trusses to be equally distant from center of track.

The south trusses of all through spans to be so arranged that if it is desired to double-track the bridge at any subsequent time, they can be replaced by heavier trusses and the old trusses moved out and placed in the proper position for a three-trussed double-track bridge; by this arrangement the floor beams will not be changed. The nearest edge of inclined end posts of heavy truss to be seven (7) feet from center of either track, and the outside trusses will be about seven (7) feet six (6) inches. Span No. 3 to be a double cancellated truss. Panels to be same length, measured on center of track. By this arrangement there will be a short panel at one end of each truss and a long one at the other end, the short panel in one truss being opposite the long panel in the other truss. Panels about sixteen (16) feet six (6) inches in length.

Floor Beams.—The floor beams to be placed at right angles to the center line of the track; to be composed of plate girders two (2) feet deep, suspended by wrought-iron plates from the chord pins, the plates being riveted to the floor beam, having several strengthening plates at the end of floor beams and a bent angle at the top of floor beams as shown.

Stringers.—Two longitudinal plate girder stringers, twenty (20) inches deep, to be riveted to floor beams, as shown; to be five (5) feet from center to center. The stringers to be covered with ties of best quality white oak, six (6) inches by nine (9) inches by nine (9) feet (except those as specially referred to for elevating track on spans 3 and 4), spaced twelve (2) inches, center to center.

Guards.—One foot distant in the clear outside of rails, guard timbers will be placed, eight (8) inches by six (6) inches in section, of best quality white oak, notched down one-half (½) inch on ties, supported by two lines of best quality white pine stringers.

Wooden Stringers.—The wooden stringers to be bolted at the ends to bent angle rests or chairs riveted to floor beams. The guards to be bolted to the wooden stringers on each side of each floor beam through the ties, wooden stringers and chair, and twice between floor beams. The ties, as well as guards, to be counter-sunk one-half (½) inch. The wooden stringers to be six (6) inches by sixteen (16) inches in section.

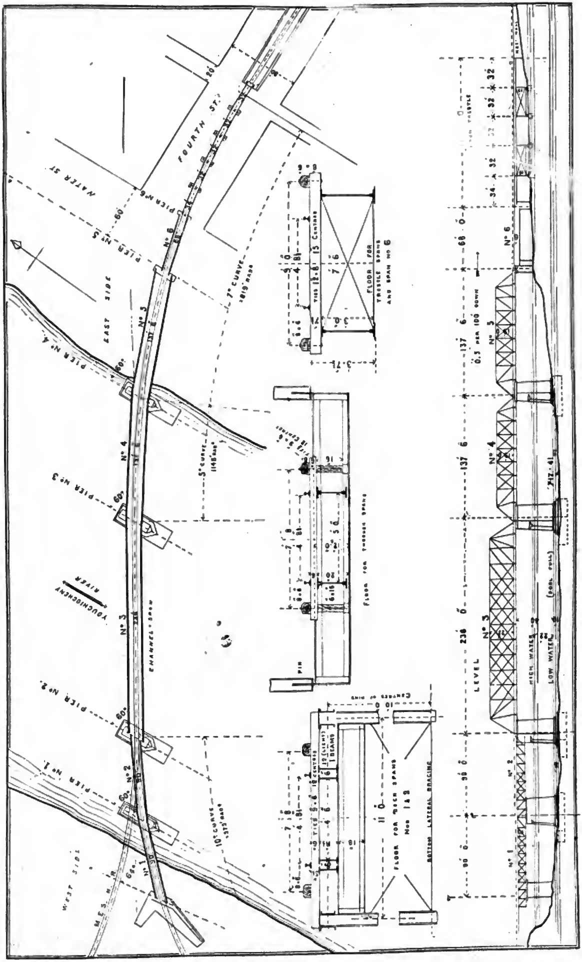
Posts.—The posts of trusses to be continued to the top of the floor beams. The trusses to be twenty-seven (27) feet deep, center to center of chords; to have lateral bracing between trusses at every panel, at a height of nineteen (19) feet from the base of rail to the bottom of braces; also, vibration rods between top chord bracing and intermediates. The trusses to be braced laterally at top, intermediate and at bottom.

Spans 4 and 5.—Spans 4 and 5 are practically alike so far as design of truss and length of spans are concerned, both single cancellated trusses, measuring one hundred and thirty-seven (137) feet six (6) inches on chords, center to center of piers. Span No. 4 is on a five (5) degree curve. Span No. 5 is on a seven (7) degree curve. The floor systems to be the same as on span No. 3, likewise the arrangement of panels, which will be about fifteen (15) feet long.

Floor beams to be at right angles to center line of truss. At no point, either at the ends of the spans or centers, shall there be less than seven (7) feet clearance between center of track and nearest point of inclined end posts or projection of top chord. The same arrangement of trusses for double tracking shall be as provided in span No. 3. The trusses bearing an excess of moving load, owing to the curve, shall have their parts increased for the additional loads. The outer rail to have an elevation of three-quarter (¾) inches over the inner rail on both spans. The center of track being on the regular grade. The elevation being made in the ties, as mentioned in spans Nos. 1 and 2. The elevation of outer rail commencing fifty (50) feet back on span No. 3. Trusses for spans 4 and 5 to be nineteen (19) feet deep from center to center of chords, with top and bottom lateral bracing.

The clearance way from the base of rail to the bottom of any overhead intermediate bracing or top lateral bracing, in all through spans, shall be nineteen (19) feet.

Span No. 6.—Span No. 6 to be a deck span composed of two iron plate girders, six (6) feet deep, seven (7) feet six (6) inches between center of girders. Floor system as shown in sketch marked "Floor for Trestle Spans and Span No. 6." The girders arranged to have the versed sine of curve at center of span half overcome at ends of girders and half in the center, as there is a versed sine of about eight (8) inches, the span should be placed about four (4) inches out of center at both ends.



YOUGHIOGHENY RIVER BRIDGE, McKEESPORT, PA.

The girders to be well braced laterally, top and bottom, and also to have vibration rods.

The trestles to be all of the same height, fifteen (15) feet seven and one-half ($7\frac{1}{2}$) inches from the base of rail to top of pedestal blocks. The spans to be as shown. All plate girders to be three (3) feet deep and seven (7) feet six (6) inches between centers, having top and bottom lateral bracing [illegible] vibration rods. The floor system compos[illegible] quality white oak: minimum size being [illegible] (5) inches by twelve (12) inches in [illegible] about nine (9) feet eight (8) inches lon[illegible] length to suit the curve, projecting [illegible] girders, as shown; spaced three (3) [illegible] or fifteen (15) inches center to center [illegible] on the girders, the outer rail elevated three-quarters (¾) inches. Elevation made in ties, as mentioned previously in [illegible] 4 and 5.

Guard [illegible] rails eight (8) inches by six (6) inches, best quality white oak, as shown, placed [illegible] of girders, notched one-half (½) inch on ties, and bolted to every sixth tie with three-quarters (¾) inch bolts. Two spans of the iron trestle to be braced, as shown, longitudinally and diagonally. Each bent to have horizontal cross-bracing, top and near bottom, and to have vibration rods. The foot of each post to have a large base, bolted to pedestal block with two one (1) inch bolts.

Material.—All parts of the superstructure to be composed of wrought iron, except bed-plates and washers, which may be of cast iron.

Strain Sheets.—Contractors must submit with their proposals full strain sheets for each span. The strain sheets must show for each member of every truss the total strain sustained, and the net dimensions and area of cross-section; also, the dead weight assumed in the calculation, and the resulting weight of the structure, which must not be more than the dead weight assumed. In calculating strains, the length of span shall be understood to be the distance between centers of end pins for trusses and between centers of bearing plates for all beams and girders.

The contractor will be required to furnish and build the total superstructure in place, including ties, guard rails and wooden stringers—everything but the rails.

Loads.—The entire bridge will be proportioned to carry the following loads:

Dead Load.—1st. The weight of iron in the structure.

2d. A floor weighing four hundred (400) pounds per lineal foot of *track*, to consist of the rails, ties, guard timbers and wooden stringers only.

These two items to constitute the "dead load."

Moving Load.—3d. A moving load, consisting of two "consolidation" engines, coupled, followed by a train weighing one gross ton per lineal foot. This "live load" being concentrated upon points distributed as in the diagram.

The maximum strains due to all positions of the above "live load" and to the "dead load" shall be taken to proportion all parts of the structure.

Wind Strains.—To provide for wind strains and vibrations, the top lateral bracing in deck spans and the bottom lateral bracing in through spans shall be proportioned to resist a lateral force of five hundred (500) pounds for each foot of the span, three hundred and fifty (350) pounds of this to be treated as a moving load. The bottom lateral bracing in deck spans and the top lateral bracing in through spans to be proportioned to resist a lateral force of one hundred and fifty (150) pounds per lineal foot of span. Variations in temperature to the extent of one hundred and fifty (150) degrees shall be provided for in all parts of the structure. All parts shall be so designed that the strains coming upon them can be accurately calculated.

PROPORTION OF PARTS.

1. *Tensile Strains.*—All parts of the structure shall be so proportioned that the maximum strains produced shall in no case cause a greater tension than the following:

	Lbs. per sq. in.
On lateral bracing	12,000
Bottom chords and main diagonals	10,000
Counter-rods and long verticals	8,000
Bottom flange of floor beams and stringers	7,000
Bottom flange of plate girders in span No. 6 and iron trestle	8,000

2. *Compressive Strains.*—Compression members shall be so proportioned that the maximum load shall in no case cause a greater strain than that determined by the following formulæ:

$$P = \frac{8{,}000}{1 + \frac{L^2}{40{,}000r^2}}$$ for square end compression members.

$$P = \frac{8{,}000}{1 + \frac{L^2}{30{,}000r^2}}$$ for compression members with one pin and one square end.

$$P = \frac{8{,}000}{1 + \frac{L^2}{20{,}000r^2}}$$ for compression members with pin bearings.

P = the [illegible] compression per square inch of cross-section.

L = the length of compression member in inches.

[illegible] least radius of gyration of the section in inches.

[illegible] the lateral struts shall be proportioned by the above formulæ to resist the resultant due to an assumed initial strain of ten thousand (10,000) pounds per square inch upon all the rods attaching to them, produced by adjusting the bridge.

4. In girders, compression shall be limited as follows:

In riveted plate girders used as cross floor beams, gross section, 6,000 pounds per square inch.

In riveted longitudinal plate girders, over twenty (20) feet long, gross section, 6,000 pounds per square inch.

In riveted longitudinal plate girders, under twenty (20) feet long, gross section, 5,000 pounds per square inch.

5. *Variable Strains.*—Members subjected to alternate strains of tension and compression shall be proportioned to resist each of them. The strains, however, shall be assumed to be increased by an amount equal to four-fifths ($\frac{4}{5}$) of the least strain.

6. *Shearing Strains.*—The rivets and bolts connecting all parts of the girders must be so spaced that the shearing strain per square inch shall not exceed six thousand (6,000) pounds, nor the pressure upon the bearing surface exceed twelve thousand (12,000) pounds per square inch of the projected semi-intrados (diameter × thickness of piece), of the rivet or bolt hole.

7. *Strains on Pins.*—Pins shall be so proportioned that the shearing strain shall not exceed seven thousand (7,000) pounds per square inch, nor the crushing strain upon the projected area of the semi-intrados (diameter multiplied by thickness of piece), of any member connected to the pin, be greater than twelve thousand (12,000) pounds per square inch; nor the bending strains exceed twelve thousand (12,000) pounds per square inch on the top chord pins; nor fifteen thousand (15,000) pounds per square inch on the bottom chord pins, when the centers of bearings of the strained members are taken as the points of application of the strains.

8. *Plate Girders.*—Plate girders shall be proportioned upon the supposition that the bending or chord strains are resisted entirely by the upper and lower flanges, and that the shearing or web strains are resisted entirely by the web plate.

9. *Staying of Compression Flanges.*—The compression flanges of beams and girders shall be stayed against transverse crippling when their length is more than thirty times their width.

10. *Width of Plates.*—The unsupported width of any plate subjected to compression shall never exceed thirty times its thickness.

11. *Net Sections.*—In members subject to tensile strains full allowance shall be made for reduction of section by rivet-holes, screw threads, etc.

12. *Web Sections.*—The iron in the web plates shall not be subjected to a shearing strain of more than four thousand (4,000) pounds per square inch, and no web plate shall be less than three-eighths ($\frac{3}{8}$) of an inch in thickness.

DETAILS OF CONSTRUCTION.

1. *Connections.*—All the connections and details of the several parts of the structure shall be of such strength that, upon testing, rupture shall occur in the body of the members rather than in any of their details and connections.

2. *Accessibility.*—Preference will be had for such details as will be most accessible for inspection, cleaning and painting. No closed work will be allowed in the structure.

3. *Web Joints.*—The webs of plate girders must be spliced at all joints by a plate on each side of the web. T-iron must not be used for splices.

4. *Stiffening of Webs.*—When the least thickness of the web is less than one-eightieth ($\frac{1}{80}$) of the depth of a girder, the web shall be stiffened at intervals not over twice the depth of the girder.

5. *Pitch of Rivets.*—The pitch of rivet in all classes of work shall never exceed six (6) inches, nor sixteen times the thinnest outside plate, nor be less than three diameters of the rivet.

6. *Diameter.*—The rivets used will generally be three-quarters (¾) inches and seven-eighths (⅞) inches in diameter.

7. *Rivet Holes.*—The distance between the edge of any piece and the center of a rivet hole must never be less than one and one-quarter ($1\frac{1}{4}$) inches, except for bars less than two and one-half ($2\frac{1}{2}$) inches wide; when practicable, it shall be at least two (2) diameters of the rivet.

8. *Wide Flanges.*—When plates more than twelve (12) inches wide are used in the flanges of plate girders, an extra line of rivets with a pitch of not over nine (9) inches shall be driven along each edge to draw the plates together and prevent the entrance of water.

9. *Punching.*—In punching plate or other iron the diameter of the die shall in no case exceed the diameter of the punch by more than one-sixteenth ($\frac{1}{16}$) of an inch.

10. All rivet holes must be so accurately punched that when the several parts forming one member are assembled together, a rivet one-sixteenth ($\frac{1}{16}$) inch less in diameter than the hole can be entered hot, into any hole without reaming or straining the iron by "drifts."

11. The rivets, when driven, must completely fill the holes.

12. *Rivet Heads.*—The rivet heads must be hemispherical, and of a uniform size for the same-sized rivets throughout the work. They must be full and neatly made, and be concentric to the rivet hole.

13. *Machine Riveting.*—Wherever possible, all rivets must be machine driven.

14. *Built Members.*—The several pieces forming one built member must fit closely together, and when riveted shall be free from twists, bends and open joints.

15. *Joints.*—All joints in riveted work, whether in tension or compression members, must be fully spliced, as no reliance will be placed upon abutting joints. The ends, however, must be dressed straight and true, so that there shall be no open joints.

16. *Lower Chords and Suspension Bars.*—The heads of eye-bars shall be so proportioned that the bar will break in the body instead of in the eye. The form of the head and the mode of manufacture shall be subject to the approval of the Chief Engineer. Each proposal to be accompanied by a statement giving method of manufacture of eye-bars.

17. The bars must be free from flaws and of full thickness in the necks. They shall be perfectly straight before boring. The holes shall be in the center of the heads and on the center line of the bar.

18. The bars must be bored of exact lengths, and the pin holes one sixty-fourth ($\frac{1}{64}$) of an inch larger in diameter than the pins.

19. *Packing Pins.*—The lower chords shall be packed as narrow as possible.

20. The pins shall be forged and turned straight and smooth, and shall fit the pin holes within one-sixty-fourth ($\frac{1}{64}$) of an inch.

21. The diameter of the pin shall not be less than two-thirds ($\frac{2}{3}$) the largest dimension of any tension member attached to it. Its effective length shall not be greater than the breadth of the foot of the post plus four times the diameter of the pin. The several members attaching to the pin shall be packed close together, and all vacant spaces between the chords and posts must be filled with wrought-iron filling rings.

22. *Upset Ends.*—All rods with screw ends shall be upset at the ends so that the diameter at the bottom of the threads shall be one-sixteenth ($\frac{1}{16}$) inch larger than any part of the body of the bar.

23. All threads must be of the United States standard, except at the ends of the pins.

24. *Floor Beam Hangers.*—Floor beam hangers shall be so placed that they can be readily examined at all times.

25. *Compression Members.*—Compression members shall be of wrought iron, of approved forms.

26. *Pitch of Rivets.*—The pitch of rivets for a length of two diameters at the ends shall not be over four times the diameter of the rivets.

27. The open sides of all trough-shaped sections shall be stayed by diagonal lattice work at distances not exceeding the width of the member. The size of bars shall be duly proportioned to the width.

28. *Pin Holes.*—All pin holes shall be reinforced by additional material so as not to exceed the allowed pressure on the pins. These reinforcing plates must contain enough rivets to transfer the proportion of pressure which comes upon them.

29. Pin holes shall be bored exactly perpendicular to a vertical plane, passing through the center line of each member when placed in a position similar to that it is to occupy in the finished structure.

30. *Abutting Joints.*—The ends of all square-ended members shall be planed smooth and exactly square to the center line of strain.

31. All members must be free from twists or bends. Portions exposed to view shall be neatly finished.

32. *Lateral Bracing.*—In no case shall any lateral or diagonal rod have a less area than three-quarters (¾) of a square inch.

33. The attachment of the lateral system to the chords shall be thoroughly efficient. If connected to suspended floor beams, the latter shall be stayed against all motion.

34. *Transverse Diagonal Bracing.*—All through spans with top lateral bracing shall have wrought iron portals, of approved design, at each end of the span, connected rigidly to the end posts. The diagonal bracing at the ends of all spans shall be of the same equivalent strength as the end top lateral bracing.

35. *Bed Plates.*—All bed plates must be of such dimensions that the greatest pressure upon the

Continued on page [illegible].

ENGINEERING NEWS.

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S. D. V. BURR.......................ASSOCIATE EDITOR.

SATURDAY, FEB. 18, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

THE AMERICAN WATER-WORKS ASSOCIATION.—The second annual meeting of the American Water-Works Association will be held in the City Hall, Columbus, O., on Tuesday, March 14, 1882.
J. H. DECKER, Secretary.

THE SUBSCRIPTION SEASON of most newspapers and periodicals is comprised in the first two months of the year, and by the results of these two months' business the publishers largely test the progress they are making and their readers' appreciation of their past labors. It is to the publisher very much what the periodical election is to the politician. We are pleased to be able thus early in the season to extend our thanks to the "old" subscribers to ENGINEERING NEWS for the universal promptness with which they have sent in their renewals for the current year, and it is an additional cause for self congratulation to count up the long list of new names that "somehow" have seen or heard of the paper, and esteeming it just what they want, have subscribed. In the six weeks of the present year we have taken as many new subscribers as we have usually considered a good six months' showing, and the rate of increase we are happy to say does not show any abatement as yet. One of the results of this happy state of affairs is the already total demoralization of our file of back numbers, for which we thought we had quite amply provided for months to come. Owing to the increase of new subscribers and to the demand for special numbers we are now unable to furnish a full file from the beginning of the volume except as we can buy certain numbers back from such of our subscribers as do not care to preserve them. Now, we are very much pleased to note the increasing popularity of ENGINEERING NEWS, and it is the great incentive to do more and better than we have done heretofore. We honestly think that, without fear of contradiction, we can claim ours to be *the* journal of the engineers and contractors of America, and to our columns we expect, and everybody else who knows "what's what" expects, to look for the latest and most complete record of the constructive work of the continent. "Business," first, last and all the time, is what we are after: how to make money and how to help others to make it, is our aim, and if this is looked upon as sordid, etc., by any "super-æsthetical, highly poetical" engineer or contractor, if such an one there be, we must bear up under it as best we may, and continue to hunt up projects, new and old, whereby our readers may get hold of some "lucre" if possible. The present season will be one of immense activity; engineers will be in demand; contractors will have all they can attend to; and we propose to be "up to the times" if money, brains and industry will effect it.

NEW CROTON AQUEDU[illegible]

There have been some conflicting opin[illegible] to the competency of the Croton water-[illegible] supply the city of New York with water und[illegible] meteorological conditions, and surveys have [illegible] made looking to the introduction of the Hou[illegible]tonic River, which, however, lying in an adjoinin[illegible] State, might involve some legal complications before it could be effected; in any event, it would be desirable, if possible, not to look beyond our own territory for the water supply of our metropolis.

A consideration of the rainfall and the measured amount of water which has passed over the Croton dam for a series of years would indicate that unless the demand for water in the future exceeds all reasonable computation the Croton watershed could, by a judicious system of storage reservoirs, be anticipated to meet all the demands likely to arise in this city for many years to come. If the use of the water were confined to its legitimate purpose, that is to say, to meet the domestic wants alone of the population, it could answer all the demand, under a properly regulated administration, of a city of at least 3,000,000 of people for a generation to come. But the enormous and increasing demands for water for manufacturing purposes will diminish proportionately the extent of population which could be supplied. The ultimate use of salt water for many purposes is a mere question of time, however.

From 1866 to 1880 it appears that the flow from the Croton water-shed averaged for the year as high as 600,000,000 gallons, and for no year was it less than 300,000,000 gallons daily. Setting aside the surplus of the years of greatest rain, and assuming that water could not be stored from the overplus of one year for use in the next, but that in each year the excessive rains could be stored only to the extent of supplementing the deficiencies of the current year, it appears that the basin could, with such storage, furnish 250,000,000 gallons for each and every day in the year, and to insure that daily supply a storage capacity of near 50,000,000,000 gallons would be sufficient.

It is not to be expected that the entire rainfall in years of excessive rains can be stored. Storms occurring when the reservoirs are full must run to waste, but this has been considered in the statement above of 250,000,000 gallons daily.

The fact that the existing aqueduct is heavily taxed to bring 100,000,000 gallons into the city, and if it were a safe structure and to be relied upon to that extent, which is far from the fact, still a new conduit would be needed in the early future, as the present one limits the city supply to less than half the water available from the Croton shed; and this fact had led the authorities to survey and estimate the cost of a new conduit; and a bill to authorize its construction was passed by the Legislature of 1881, but which failed to receive the Governor's sanction, on the alleged ground that the bill, as drawn, did not limit the amount which the city was authorized to expend under it, the estimate of its cost varying at different times from $12,000,000 to $20,000,000.

That this cause shall no longer operate to prevent the present Legislature from granting to the city the requisite authority, the present Commissioner of Public Works, Mr. Hubert O. Thompson, has caused detailed surveys and estimates to be made during the past year under the direction of the Chief Engineer, Isaac Newton, of the cost of a new aqueduct, capable of bringing to the city daily 250,000,000 gallons of water; an application will be made to the present Legislature for the requisite authority to construct, not an aqueduct merely, but this aqueduct, whose main feature will be, in connection with its dam, to utilize the entire rainfall of the Croton shed without other storage reservoirs than that offered by the dam itself. The storage reservoirs already constructed cost at the rate of about $200 for every million gallons stored. Subtracting the amount of storage capacity already secured or provided for, viz., thirteen thousand million gallons, leaves about thirty-seven thousand million gallons to be provided.

The proposed new dam, located on the Croton River, about 4½ miles below the present Croton dam, is a high masonry dam, giving a depth of water at the site of 185 feet, with a storage capacity estimated at near 33,000 millions of gallons, and an additional area of shed, of near 23 square miles.

The cost of this amount of storage, by the method now pursued, would amount to $6,000,000. By the location and height of the proposed dam, this same amount of storage is had at the cost of constructing the dam, and the attendant land damages, estimated at a little over $3,000,000. The proposed aqueduct will extend from near the new dam, in a very direct line towards the High Bridge, this directness, and its consequent saving in distance, being effected by constructing it for nearly the entire distance in tunnel, and in order that the estimate may be in excess of the actual cost the excavation has been estimated as rock throughout.

In introducing water from the Gunpowder into Baltimore, completed in 1878, the entire distance, nearly 8 miles, is tunneled in rock, mostly gneiss, similar to the formation in this neighborhood, but deeper shafts were then found necessary, and as [illegible]e dimensions there adopted for the tunnel excava[illegible] were precisely the same as is proposed here, [illegible] a circular tunnel of 14 ft. in diameter, and [illegible] with 2 in. of brickwork laid in cement, the [illegible] of the cost and time necessary for comple[illegible]een shafts on that work became a guide, wh[illegible]proved of great service in approximating to [illegible] actual cost which may be anticipated here; an[illegible]ddition to this precaution, in order that the [illegible] be within the estimate, it has been assum[illegible] the excavation will require a lining of 12 [illegible]ckwork although it is anticipated that m[illegible] rock w[illegible] be sound enough to render the [illegible]rick unnecessary.

The grade of [illegible]ct of 9 in. per mile will give a delivery to [illegible]ral Park rese[illegible] 240,000,000 gallons [illegible] without running under pressure.

By tapping the Croto[illegible] a point 4½ miles nearer New York, and [illegible]ving of distance effected by tunnel constr[illegible] length of the aqueduct will be shortened [illegible] of the present aqueduct by nearly six [illegible]

The project commends its[illegible] favorable opinion of the public int rest [illegible] water—plenty of it, and comparative f[illegible] accidental interruption to its use, [illegible] actual economy beyond that of any othe[illegible] which has been brought forward for the water supply of this city. This plan might be thought by some of doubtful feasibility, and at first sight its apparent boldness is rather startling, but there is nothing connected with the project which has not been successfully carried out elsewhere, with the single exception that the proposed dam is some 20 feet higher than any known construction for similar purpose. Stone dams have been successfully built and in use for years, of 160 feet in height, notably at Furens in France, and no practical difficulty whatever exists for carrying them 25 feet higher. With the improvements introduced of late years in the machinery applicable to all branches of construction, neither the tunnel nor the dam offer any obstacle to its successful and economic construction, or to accuracy in estimating the time and cost necessary to its completion.

The site of the dam has been thoroughly examined by boring, and shows a continuous rock foundation, in a comparatively narrow valley with abrupt side slopes abounding in rock suitable for such masonry as is proposed. Nor is the land flooded, notwithstanding its proximity to the city, either very valuable for farming or building purposes.

And the principle of tunneling for the line of conduit instead of making open cuts and embankments has many advantages without adding to the aggregate cost; and, if thought desirable, could be continued under Harlem River instead of by an elevated aqueduct on arches, and at less cost than the latter, as sound rock occurs in the bed of the river at the crossing, rendering it but little more expensive to tunnel than the same length on the remainder of the line of aqueduct.

The aggregate cost of the contemplated work, including the largest possible margin for contingencies, is $14,000,000, which embraces the entire work to the reservoir in Central Park.

GREAT MORTALITY IN BUFFALO.

THE CITY DECLARED TO BE ONE OF THE MOST UNHEALTHY IN THE UNITED STATES.

A Buffalo dispatch of the 12th to the New York *Times* says: "The Health Physician reports that Buffalo has become one of the most unhealthy cities in the United States. The present death-rate is double what it was a year ago. The report of the National Board of Health, compiled from the mortuary statistics of the chief cities of the nation for the past 13 weeks, shows that the death-rate of Buffalo has reached the alarming figure of 39 per 1,000. Small-pox, typhoid fever, diphtheria, scarlet fever, measles, cerebro-spinal meningitis, and all forms of zymotic disease, are having deadly sway in our midst, while consumption is claiming an unusually large number of victims. The open winter has had something to do with the alarming increase in mortality, but, as a matter of fact, the sanitary condition of the city is bad. The Fifth Ward is a hotbed of fever in every deadly form, for which the presence of cattle barns in the midst of densely populated neighborhoods and the absence of adequate sewerage are largely responsible. It is a stern truth which cannot be controverted that the National Board ranks it with the most unhealthy cities. The barns referred to are maintained by certain distilleries and the cattle are fed on distillery slops. These cattle are in such a condition that the stench from them is unbearable. They get sick from the stuff they are fed on and lie in thick mud. What is done with them is a mystery.

The sewers get choked with the filth that is drained into them from these pens, and when heavy rains come the houses in the vicinity become saturated with this foul mass, creating an odor that is perceptible for a long distance. On some days the people are obliged to close their little homes and escape to some place where they can breathe untainted air. They dare not open their windows for ventilation, for the air comes in laden with poisonous exhalations. In [illegible] block more than 40 persons are prostrated at the present time with fevers.

[Buffalo has no one to thank but herself for this, in listening to self-elected committees who have delayed the abatement of the notorious Hamburgh Canal nuisance until such time as they can themselves be brought by [illegible] experience to understand the value of the plans reported upon by sanitary engineers as essential to the health of the city.

Of all the cities in our country, we know of none the surroundings of which would seem to be so well suited to the highest sanitary attainment as that of Buffalo.

Situated on the shore of a wide, deep, and rapid river, having a current of from 6 to 10 miles per hour, furnishing a vehicle for the complete removal, and indeed the destruction, of anything cast into it, with ample slope for surface drainage of the city. An inexhaustible supply of water at her very door. The direction of the prevailing wind (rarely so gentle as a breeze) being directly from the ocean expanse of the lake, tending to sweep away any unwholesome exhalations, and all of no use so long as man, in his stupidity, will continue to ignore the teachings of experience, if they point to the necessity of parting with his dollars.

And here comes in the evils of quackery. Of all localities which occur to us, Buffalo is the least suited to the requirements of what is called the "separate system" of sewering. But in ignorance of its needs and necessities, and assured by interested parties of its greater economy, and filled with the idea that it was a new method of sewering, and so an improvement on existing methods, some of its citizens have had sufficient influence to throw obstacles in the way of the authorities, who, under professional advice, were prepared to inaugurate the system of sewerage, which, in accordance with the experience of older cities, would have removed the impediment which now exists to the proper sanitary condition of the city, viz., the Hamburgh Canal waters, which now reek with the pollution from the worst portions of the city, and the necessary cost of proper proceedings for the purification of this canal on the combined system is said by these quidnuncs to be so greatly in excess of the separate system, or new method, as they call it, that until more light is had on the subject, or, in other words, until they are themselves educated up to the standard of their neighbors, nothing shall be done. Much as we would deplore the sacrifice of young and innocent lives, we cannot but hope that it will be productive of good. Nothing short of such a visitation as they have had would have opened their eyes to the dangers of a *little* knowledge of an intricate subject.]

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SEWERAGE AND DRAINAGE.

Property owners in town and country will be glad to learn that these two practical questions, which belong to the health and comfort of every householder in the State, are receiving the attention due to their importance. Prof. Gardner, chief of the New York State Survey and ex-member of the State Board of Health, has just made a valuable report to the State Board. Part of his report is based upon recent careful examinations in England, and part of it upon examinations and reports in the United States. His conclusions are that the combined system of sewerage is everywhere a failure. In London and Manchester it is pronounced a total failure by the best English engineers, and what is true of London and Manchester under like conditions is also true of the rest of the world.

The saving in expense of the lesser or single system is from one-half to three-fifths of the expense of the combined system. The best example of success in the new system is the city of Memphis, which is attracting almost as much attention in England as in the United States. What cost in Memphis about $187,000 in separate small sewers, would have cost from $837,000 to $2,125,000 for what is known as the combined sewer system, according to the estimates made at the time. In this respect, for what has been done, Memphis has so far proved an example to all the world. In Rochdale, France, (?) a like success has attended the experiments made. The separate and small sewers are for homes and places of business, and when the storm waters cannot be carried off on the surface, they should be provided for separately, but as a law the storm sewerage should have no connection with the homes of the people.—*Mail and Express.*

Every householder in the State, both town and country, will be glad to learn that so distinguished a scientist and sanitarian as an ex-member of the State Board of Health has had their comfort in view in some late studies of his abroad. With this pleasing [illegible], there will be mingled, we regret [illegible] of sadness that such transcendent talents as those shown by the ex-member of the State Board of Health, in concluding from his personal observations that, what fails of success in London and Manchester is worthless the world over, should receive so little consideration from the public that their possessor should be put in charge of a topographical survey merely, instead of some more immediate application to the comfort and health of all the householders of the State, of the results of his wonderfully close observations abroad, by being charged with the supervision of the sewerage and drainage of the State generally: instead of, as at present, merely mapping out some of its waste lands. With this sadness, fortunately, will come the soothing reflection that it is just possible the distinguished ex-member of the State Board of Health has made a slight mistake in drawing his deductions—possibly has got his facts a little mixed—mayhap, has not the facts at all—and so the householder may be content with the assurance in his own mind, that the sole fact which appears in the case is the one that the ex-member of the State Board of Health is, after all, well placed, and no injustice is done him by committing to him the surveying of the waste lands of the State, as business well suited to his talents.

It seems that "the best example of success in the *new* system of sewerage is the city of Memphis, which is attracting almost as much attention in England as in the United States."

In the first place, it is by no means a *new* system, but has been recommended by engineers, wherever the circumstances of the locality called for it for the last 30 years (vide Rudolph Hering's report to National Board of Health, Engineering News, Jan. 28, 1882), and in the case of Memphis is incomplete in that the city is sewered (after a fashion) but is not drained at all. Wherever drainage is as necessary as sewerage, which is the case in large cities, the separate system, to be as complete and as efficacious as the combined, is more expensive than the latter. (Vide same Report of Hering's.) As to the system adopted in Memphis being "an example to the whole world," we only know that it is not the fault of the designer, if it be not, as he loses no opportunity to sing its praises in more of the languages of Europe than we can comfortably master.

That the sewering of the town of Rochdale, in France, should be held up as an example of the benefits to the rest of the world, to be anticipated from following the example of the City of Memphis, in its system of sewerage, may be a discovery of the distinguished ex-member of the State Board of Health and Chief of the New York State Survey, but it will fail to strike the ordinary mind in that light.

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BROOKLYN ELEVATED ROADS.

The judges, Barnard, Gilbert and Dykeman, composing the general term of the Supreme Court have rendered their decision refusing to grant the right to the East River Bridge & Coney Island Rapid Transit Company (Culver's road) to build an elevated road on Water, Washington, High, Willoughby and Pearl streets and Flatbush, Fifth and Seventh avenues.

Summed up, the grounds upon which the adverse opinion is based is as follows:

First.—That compensation is not assured.

Second.—That construction of an elevated railway on city streets, without compensation, is confiscation.

Third.—There is not disclosed a public necessity sufficient to justify the court in permitting the erection of this railroad against the dissent and opposition of more than one-half of the owners of property along its line.

Work would have been commenced on the road forthwith, but this action of the court may be regarded as disposing of the case beyond any further controversy, as under a late decision of the Court of Appeals, "where the decision of the general term involves no point of law such decision cannot be reviewed."

There is a happy uniformity of opinion in our sister city that rapid transit is absolutely essential to its future interests. Something must be done to induce the overflow from New York to occupy these vacant lots, already sewered, curbed, lighted, paved and watered, but vacant, ready for owners to build. If they could but get to their places of business in New York within the same space of time that they reach Westchester there would be an inducement to take up their homes in Brooklyn, but failing this assurance, small merchants and mechanics whose business is in New York, very naturally, wish to be as near in *time* as possible to their business, and will not look to Brooklyn as long as there is a vacant lot in the upper part of New York island.

The mayors, influential citizens and the press of Brooklyn frequently break out in eulogies of a system of rapid transit which shall accommodate their outlying districts without interfering in any way with the streets or property near the center of the city, whose occupants are happily so situated as not to need such facilities, and are complacently looking for the advent of some genius in their midst who will solve this intricate problem for them. In the meantime, waiting this advent, they have defeated every feasible scheme offered, whereby capital could be induced to test what at the best would be but an experiment, so far as a return on capital invested in rapid transit is concerned, and they now have the prospect of waiting a while longer. When the bridge is opened, however, we shall find some of the demagogues and interested individuals who have been loudest in opposing everything which did not pay prospective damages for the use of the streets, in something of a quandary; unless with great inconsistency, they admit that some one may with propriety be hurt for the good of the majority; they will find themselves with an elephant on their hands, useful, it is true, like Barnum's, in making a *big show.*

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PERSONAL.

Count De Lesseps is reported seriously ill at Cairo.

Mr. Henry M. Wightman has been re-elected City Engineer of Boston.

General Rosser, chief engineer of the Canada Pacific Railway, has resigned.

C. A. Allen has been unanimously re-elected City Engineer of Worcester, Mass.

Mr. Thos. H. Tracy has been appointed City Engineer of London, Ont., at a salary of $2,400 per annum. He is the first permanent engineer that has held the position.

Mr. F. J. Smith, who was constructing engineer for Henry R. Worthington for thirteen years, has accepted the position of Chief Mechanical Engineer of the St. Joseph (Mo.) Water-Works.

Jacob Gessert, late Superintendent of Police of Cincinnati, O., committed suicide on the 15th inst. Mr. Gessert served several years as a member of the Board of Public Works of Cincinnati. He leaves a wife and nine children.

Mr. Charles W. Stevens, formerly of San Francisco, died on the 13th at 165 East Twenty-seventh street, this city, where he has been living for the past four months with his family. Mr. Stevens was a civil engineer and master mechanic. He built the first locomotive run in California, and superintended the building of the first railroad in Oregon. The remains will be taken to Concord, N. H.

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

Feb. 15, 1882, the Society met at 8 p. m., President Welch in the chair.

A paper by Mr. R. E. McMath, of St. Louis, member of the Society, subject, "The Mean Velocity of Streams Flowing in Natural Channels," was read by the Secretary in the absence of the author. With this paper was presented a set of diagrams of curves, deduced from the experiments of J. B. Francis, member A. S. C. E., at Lowell, from the observations of Gen. Theo. G. Ellis, member A. S. C. E., upon the flow of the Connecticut River; from the records of the flow of the Mississippi, made by Gens. Humphreys and Abbott, and also from various other observations of the flow of the Mississippi at Columbus, Ky.; at Vicksburg, Miss.; at Carrollton, La., and at the Passes at the mouth of the Mississippi.

The author of the paper then presents for consideration and discussion the suggestion that to determine a reliable rule for the flow of streams in natural channels, the considerations affecting an artificial channel should be kept entirely distinct, that the definite law of discharge over a weir is usefully applicable at any transverse section above and within the influence of the weir, dam or shoal; that the relation between mean and maximum velocity cannot be used in streams of irregular section; that head is pressure, but not in all cases fall of surface; that in natural streams, the bars or shoals are substituted for the weir or dam; that the level of no discharge is determined by the horizontal plane through the crest of a weir, dam or natural bar; that two new hydraulic terms may be used, viz.: Permanent area, or that part of transverse section below the plane of no discharge, and ruling depth, or depth of the plane below the surface. Formulæ are then suggested in application of these considerations. The paper was discussed by Messrs. T. C. Clarke, Ashbel Welch, F. Collingwood, Joseph P. Davis and Charles E. Emery.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 51.

CC.—MEDFORD.

Medford, Massachusetts, in lat. 42° 25′ N., long. 71° 7′ W., is on a small river in a valley surrounded by high hills. It was settled and incorporated as a town in 1630.

Water-works were built by the town in 1870, after the plans of Shedd & Sawyer, civil engineers, taking the supply from Spot Pond, a natural lake of 296 acres area, and about 2 square miles watershed, 130 ft. higher than the town, to which the water is conveyed through 2 miles of 12-in. wrought-iron and cement pipe. Distribution is through 30 miles of the same kind of pipe, from 10-in. to 2-in. diameter, with 152 fire hydrants, 258 gates, 2,585 taps and 9 meters. The town pays $3,000 per year for street sprinkling and fountains.

The population in 1880 was 7,554. The daily consumption is not given.

The works have cost $320,000, and the gross receipts to Jan. 1, 1881, were $137,888.27. The bonded debt is $300,000, bearing interest at 6 per cent.

The expenses of maintenance were $4.133.52 in 1880, and $3,409.90 in 1881. The receipts in 1880 were $16,287.82, and in 1881 $16.566.18.

The works are managed by five commissioners. R. M. Gow is the Superintendent and C. B. Buss the Clerk.

CCI.—MAHANOY CITY.

Mahanoy City, Pennsylvania, in lat. 40° 43′ N., long. 76° 48′ W., is at the confluence of two small streams in a mountainous region. Settled in 1860, it was incorporated in 1861. Water-works were built in 1864 by a private company, under the direction of E. S. Silliman, taking the supply from springs and a stream on the Mahanoy Mountain, with a water-shed of 5 square miles. A dam 700 ft. long and 22 ft. high forms an impounding reservoir 350 ft. above and 1¾ miles from the city, to which the water is conducted through 10-in. cast-iron pipes.

Distribution is through 2½ miles of 6-in. and 8-in. cast-iron pipe, with 17 fire hydrants, 11 gates and 720 taps. The city pays $10 per year for each hydrant. The population in 1880 was 7,350. The daily consumption is not known.

The capital stock of the company is $56,250. The works have cost $78,500. The bonded debt is $1,800 at 6 per cent. Further financial statistics are not given. Edward S. Silliman is President of the company.

CCII.—EMPORIA.

Emporia, Kansas, in lat. 38° 23′ N., long. 96° 17′ W. is on the Cottonwood River.

Settled in 1857, it was incorporated as a city in 1870.

Water-works were built in 1880 by the city, after the plans of Russell and Alexander, taking the supply from a well 26 ft. in diameter and pumping directly into the mains, by a steam pump of 6-in. diameter and 21-in. stroke. The ordinary pressure maintained is 45 lbs., and the fire pressure 125 lbs.

Distribution is by cast-iron pipe of from 10-in. to 2-in. diameter, of which 12 miles are laid, with 43 fire hydrants, 41 gates and 187 taps. The town does not pay for hydrants.

The population in 1880 was 4,868. The daily consumption is not stated. The works cost $65,000, which is the amount of the bonded debt bearing 7 per cent. interest. Further financial statistics are not furnished. The works are managed by the Water Committee of the Council. D. Hammond is the Superintendent.

CCIII.—IONIA.

Ionia, Michigan, in lat. 43° N., long. 84° 55′ W., is on level ground at the foot of a bluff, ¾ mile from Grand River.

Settled in 1842, it was incorporated in 1875. Water-works were built by the city in 1876, after plans of George Briggs and James Bell.

The water comes from springs on the hill within the city limits, and passing through a marshy piece of ground for about a quarter of a mile is collected in a wooden tank, 44 ft. above the main street. It is distributed through ¼ mile of 10 in., ¾ mile of 8-in., and ⅓ mile of 4-in. cast-iron pipe with 8 fire hydrants and 100 taps.

The dam built to retain water has broken away twice, and the city counsel have refused to rebuild or repair it until a plan for permanent enlargement of the works is decided on.

The population in 1880 was 4,700. The daily consumption is not given.

The works have cost $17,000. There is no debt. The cost of maintenance in 1880 was $450, and the receipts $1,100 in 1880 and $1,300 in 1881. Frank C. Sibley is the Superintendent.

CCIV.—MALONE.

Malone, New York, in lat. 44° 51′ N., long. 74° 17′ W., is on the Salmon River, 11 [illegible] from the Canada boundary, in an undulating country. Settled in 1805, it was incorporated as a village in 1853.

Water-works were built by a private company in 1857, taking the supply from three springs, from which the water is conducted by a [illegible] wrought-iron and cement pipe to a reservoir of earthwork, 60 by 30 ft. and 8 ft. deep, 75 ft. above the village. To insure a supply when the springs are low a dam of logs and planks has been built across a small branch of the Salmon River. The water used from this source is filtered through charcoal, sand and gravel before admission to the conduit.

Distribution is by 4½ miles of wrought-iron and cement pipe of from 6 to 8-in. diameter, and 8½ miles 2-in. and 1-in. wrought-iron pipe, with 17 fire hydrants, 30 gates and 250 taps. The village pays $10 per year for each hydrant.

The population in 1880 was 4,300. The consumption is not stated.

The capital stock of the company is $45,000. The cost of the works is reported at that amount.

The receipts in 1880 were $6,000. Further financial statements are not given.

Benjamin Webster is the Superintendent.

CCV.—HINGHAM.

Hingham, Massachusetts, in lat. 42° 16′ N., long. 70° 54′ W., is on undulating ground on the shore of Massachusetts Bay. It was settled in 1630. Water-works were built by a private company in 1880, after the plans of Marshall M. Tidd, C. E., taking the supply from Accord Pond, a natural lake of 98 acres, 133 ft. above tide, reserving the drainage of about half a square mile. An old dam at the outlet was strenghtened by a concrete wall 2 ft. thick built in its centre. A 16 in. cast-iron pipe laid 80 ft. into the pond conducts the water to a screen well, whence it is distributed through 20 miles of wrought-iron and cement pipe of from 14-in. to 2-in. diameter, with 75 fire hydrants, 55 gates and 500 taps. Four meters are used. The town pays $1,500 per year for fire supply and water for the public buildings.

The population in 1880 was 4,324. The consumption is not known.

The capital stock of the company is $120,000. The works have cost $118,000, and the receipts, so far, have been about $10,000.

Charles W. S. Seymour is the Superintendent.

CCVI.—WAVERLEY.

Waverley, New York, in lat. 41° 59′ N., long. 76° 28′ W., is in a rolling country. A small stream flows through the village. Settled in 1840, it was incorporated as a village in 1855.

Water-works were built by a private company in 1880-1, after the plans of Peter Hogan, C. E. The supply is taken from a drainage area of about 2 square miles of cleared and cultivated lands, the water of which is impounded by an earth dam 50 ft. high and 150 ft. long. The outer slope is 1½ to 1 and the inner 2 to 1. A masonry wall 8 ft. thick and 35 ft. high is built in the center of the dam. A small leak occurred through a fissure in the rock around the end of the breast wall of the dam. The reservoir covers 10 acres, holds 58,000,000 gallons and is 100 ft. above the village.

Distribution is by 5 miles of cast-iron pipe of from 12 to 4-in. diameter; 2 miles being of the latter size. There are 28 fire hydrants, 25 gates and 90 taps. The town pays $1,825 per year for use of hydrants. Galvanized iron pipe is used for services.

The population in 1880 was 3,000. The daily consumption in 1881 was estimated at 250,000 gallons.

The capital stock of the company is $20,000. The works have cost $52,000. There is a bonded debt of $30,000 at 6 per cent.

The receipts to Jan. 31, 1882, were $3,700.

J. T. Sawyer is President and J. B. Floyd Secretary of the company.

CCVII.—GOUVERNEUR.

Governeur, New York, in lat. 44° 20′ N., long. 75° 20′ W., is on the Oswegatchie River, which rises in the Adirondack Mountains.

Founded in 1810, it was incorporated as a village in 1847.

Water-works were built by a private company in 1867, taking the supply from the Oswegatchie River, and pumping directly into the mains by rotary pumps built by the Holly Manufacturing Co. In 1878, Green rotary pumps were substituted for the original ones. The pumps are driven by water power from a dam on the river. The ordinary pressure maintained is 35 lbs. per square inch, and the fire pressure 80 to 90 lbs.

Distribution was at first by wrought-iron and cement pipe. Some trouble from breaks has been experienced, and cast-iron pipes are now used for extensions.

A mile and a half of pipe is in use, with 16 fire-hydrants, 7 gates and 80 taps, besides 3 fountains. The town pays $600 per year for the use of hydrants. The population in 1880 was 2,100. The daily consumption is not known. The works have cost $30,000. There is no debt. The expenses in 1880 were $500 and the receipts $1,600. Charles A. Van Duzer is the Superintendent.

CCVIII.—ST. LOUIS, MICH.

St. Louis, Michigan, in lat. 43° 25′ N., long. 84° [illegible]′ W., is on Pine River, a small stream which flows through a rolling country richly timbered, and used extensively for water power for mills. Settled in 1858, it was incorporated in 1870.

Water-works were built by the city in 1879-80, after the plans of Stiles Kennedy. The supply is taken from the Pine River and pumped directly into the mains. For ordinary use a pressure of 33 to 35 lbs. is maintained by a pump driven by a 56-in. turbine, and for fire pressure of 145 lbs., a steam pump with [illegible] cylinder of 12-in. stroke is used.

Distribution is [illegible] wooden pipe, of which 1½ miles, of [illegible] diameter, are laid, with 21 fire hydrants, [illegible] taps. Two meters are used.

The population in [illegible]. The daily consumption is not known.

The works cost $8,000. The bonded debt is $[illegible] at 5 per cent. Further financial statements are not given.

Stiles Kennedy is President and Eugene King Superintendent of the company.

CCIX.—SLATINGTON.

Slatington, Pennsylvania, in lat. 40° 46′ N., long. 75° 33′ W., is on the Lehigh River. Trout Creek divides in into the upper and lower towns. Settled in 1850, it was incorporated as a borough in 1861, in which year water-works were built by a private company, taking the supply from springs collected in a covered reservoir 40 × 70 ft. In 1873, several additional springs were connected with the reservoir, furnishing a supply of about 30,000 gallons per day. This reservoir is 30 ft. above the upper town, and about 125 ft. above the lower town. In 1881, several other springs, lying 75 ft. above the town, were collected and brought into the reservoir, doubling the supply. The water comes from the slate formation, and is very pure.

Distribution is by cast-iron pipe, of which 3 miles are laid, of from 6-in. to 4-in. diameter, with 150 taps. There are no fire hydrants.

The population in 1880 was 1,680. The consumption is not stated.

The capital stock of the company is $6,000. The works have cost $10,000. There is a bonded debt of $10,000 at 6 per cent.

The expenses in 1880 were $100 and the receipts $900.

O. A. Neff is President of the company.

CCX.—PRAIRIE DU CHIEN.

Prairie du Chien, Wisconsin, in lat. 43° 3′ N., long. 91° 35′ W., is on a slightly rolling prairie about one mile wide, between the Mississippi River and high bluffs.

Settled in 1776 it was incorporated as a city in 1878. Water works were built by a private company in 1877, after the plans of Ira P. Brunson. The supply is taken from an artesian well of 6-in. bore and 975 ft. deep. The first 150 ft. is through sand and was at first cased with an iron pipe. This rusted out and was replaced with copper. The rest of the well is through rock. The water is strongly mineral and saline and is unfit for household use. It is discharged at the surface with a head equal to 55 ft. and led through 1,500 ft. of 6-in. cast-iron pipe in the main street, in which there are 6 fire hydrants and 40 taps. The city pays $22 per year for each hydrant.

The population in 1880 was 3,000. The consumption is not known.

The capital stock of the company is $5,000, which represents the cost of the work. The well cost $3,000.

The receipts have amounted to $2,000. In 1880 the expenses were $45 and the receipts $600.

Ira P. Brunson is the Superintendent.

(TO BE CONTINUED.)

The receipts of statistics as followe is acknowledged with thanks:

From G. W. Jones, City Clerk, statistics of the water-works of Litchfield, Ill. From A. H. Martine, Superintendent, eighth annual report of Watuppa Water Board, Fall River, Mass. From S. Y. Broadstreet, Superintendent, statistics of the water-works of Monticello, Ia. From J. Albert Mills, Superintendent, water rates and blank permits used in St. Catharines, Can. From Herbert B. Newhall, Chairman Construction Committee, statistics of the water-works of East Saugus, Mass. From Charles M. Storms, Water Commissioner, statistics of the water-works of Port Byron, N. Y. From Guy Kinne, President, statistics and water rates of the water-works of Richfield Springs, N. Y. From C. B. Buss, Clerk Water Board, statistics and water rates of the water-works of Medford, Mass., and annual reports 1872 to 1881. From C. A. Miller, Secretary and General Manager, statistics and water rates of the water-works of Susquehanna, Pa. From M. A. Gould, City Engineer, statistics of water-works of Moline, Illinois. From N. T. Sleeper, Secretary, statistics of the water-works of Rockland, Maine. From Wm. Kirkham, Superintendent, statistics and water rates of the water-works of Petersburg, Va. From William F. Codd, Superintendent, statistics and water rates of the water-works of Nantucket, Miss. From J. H. Decker, Superintendent, statistics and water rates of the water-works of Hannibal, Mo. From A. J. McPike, Superintendent, statistics and water rates of the water-works of Vallejo, Cal. From C. W. Shippee, Secretary, statistics and water rates of the water-works of Milford, Ma[illegible] From Charles E. Fowler, Superintendent Po[illegible]keepsie water-works, statistics of the [illegible] works of Tarrytown, N. Y. From Jos. McCh[illegible] Secretary, statistics of the water-works [illegible]ville, N. J. From W. W. C. Sites, Chie[illegible]er, statistical figures of the Jersey wa[illegible] to Dec. 31, 1881. From E. P. Clark, W[illegible]istrar, revised statistics of the water-w[illegible] Holyoke, Mass., with statement that J. [illegible] is the Superintendent, and that E. [illegible]vie has not been connected with the wor[illegible] 1873.

The request for statistics [illegible] Denison, Texas, is returned by W. J. Scot[illegible] with the indorsement, "Local option n[illegible] force," which is supposed to mean that there are no water-works in that city.

CORRECTIONS Feb. 11, 1882, p. 50. *Auburn, Me.*—For N. J. Jordan, read N. I. Jordan. *Louella, Pa.*—For Benjamin F. Shaw, read Benjamin F. Slaw. The same corrections are to be made in the acknowle[illegible]ts on p. 51. *Chicopee, Mass.*—E. R. Stickne[illegible] Water Co., corrects history of the works [illegible]ting that the first supply from springs in [illegible] as introduced by Charles McClallan. S[illegible] Bettes designed the works built in 1877. T[illegible] corrected statistics of Jersey City and Hol[illegible] are as follows (see pp. 31 and 32, Jan. 28, 1882):

	JERSEY CITY.	HOLYOKE.	
Cost of construction to Jan. 1, 1882, excl. int. and maint	$4,938,493 21	Jan. 1, 1881..	$312,142.29
Bonded debt	$4,838,000.00		250,000.00
Daily consumption, 1881....	15,979,285 galls.	1880..	2,000,000 galls.
Cost of maintenance, 1881	$68,078.20	" ..	$4,742.06
Revenue, 1881......	$466,817.55	" ..	43,047.33
Miles of pipe, 1881	154.5	" ..	24.7
No. of fire hydrants, 1881......	1,500	" ..	140
Head in ft., 1881......	161.5		....
No. of meters, 1881.	158	" ..	50

HYDRAULIC MOTORS.

A system of hydraulic motors has been introduced into the freight-stations of some English railways which presents many novel features. As every one knows, an immense amount of merchandise is handled at these stations, and it is necessary to provide accommodations for receiving and dispatching a large number of cars during the 24 hours. With us this would be done by securing ample yard room and filling it with parallel tracks and switches; but ground in London and Liverpool is costly, and the English managers of transportation are more careful than ours to keep the goods entrusted to them protected from the weather, so that it is found more satisfactory to build the structures for the reception and delivery of freight at the more important points in two stories, hoisting the cars bodily from one to the other, to be loaded or discharged. Moreover, space is found to be saved by arranging the tracks for the storage of cars not immediately needed for use transversely to the main tracks, from which they are shifted by means of rows of turn-tables, which will take six or seven cars at once from a train and transfer them to their proper places without the tedious hauling of the whole train back and forth over the switches, by which the same object is generally accomplished here, and the transfer of single cars, for which our yard-masters would have to employ a locomotive, is there obtained by the aid of horses or special motors.

For such applications of a moderate power at any desired point the hydraulic motor is found very suitable. The power is derived from one or two accumulators on the Armstrong principle, in which water is pumped into a cylinder under a piston loaded with a weight of 30 or 40 tons, furnishing a constant pressure, which is transferred to any part of the freight-yard, or indeed to a greater distance, by means of iron pipes laid underground, beyond the reach of frost. The conversion of this force into motion at the desired points is eff[illegible] by capstans, similar in everything exce[illegible] to some of our familiar water-motors, [illegible]pplied like a hydrant by a simple valve w[illegible] long stem. Posts with revolving caps, [illegible]izontal pulleys, serve to transmit the power in any required direction, and three men, of [illegible] one manages the capstan, the second r[illegible] with the rope and hook from place to place, [illegible] the third stops the cars at the required point [illegible]eans of the brake, can move safely 150 [illegible] 200 cars every 24 hours. The raising of the loaded cars to the store-rooms in the lofts of the freight-houses is accomplished by hydraulic elevators of simple construction, and the water, after having performed its work, is returned to the accumulator to receive a new charge of force. The main supply-pipe is arranged to form a complete circuit, the water in which is always, by hydrostatic law, under nearly the same pressure as in the accumulator, a small loss being caused by friction. Each machine, whether capstan or elevator, takes its supply from the main circuit through a short branch pipe, which is furnished with a valve so that any machine can be cut off for repairs without affecting the operation of others, and an air cushion attached to the main conduit prevents water-hammer in the pipes from action of the machines. The pipes are made of cast iron, put together with sleeve-joints packed with gutta-percha and secured by bolts, and tested to about three times the actual working pressure. With our acknowledged skill in making and putting together wrought-iron pipes, it seems as if the hydraulic conveyance of power might be found very useful in this country. The capstans are estimated to furnish from 80 to 85 per cent. of the power developed in the accumulator, so that this mode of transmission compares not unfavorably in point of economy with that by means of belts or gearing, while it is in many ways much more convenient. There is no limit to the distance to which power can be carried, and by the introduction of the cheap and simple hydraulic motors now used all steam engines, shafting, pulleys and belts might be banished from manufacturing establishments of the lighter class, to be replaced by one or two lines of pipe, supplied from a street main, and controlled by stop-cocks in a way which is very favorable to precision in workmanship. Already such a system has been introduced into one or two towns of Yorkshire, and the principle is capable of very wide application. Of course any form of hydrostatic pressure could be substituted for that produced by the action of pumps with the same result.—*American Architect and Builder.*

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THE TIMBER SUPPLY OF THE UNITED STATES.

One of the most novel and interesting features of the census of 1880 is the map and statistics of the timber supply of the country, prepared by Professor Sargent, of Harvard, who is the special agent to collect statistics relative to forestry. The maps are the most interesting feature, presenting as they do not only the extent of the territory in States where there are forests valuable for timber, but those portions of the timber land which have been cut over. Nothing finer than the execution of this map work can be found, while the facts relative to location, character of the timber, its availability for market, give an idea of the magnitude of the work which Professor Sargent has performed. The bulletins and maps relating to forestry which have been issued thus far relate to those large tracts of pine timber to which the country must look for its main supply of this valuable wood. Thus far the maps cover seven States. The following are the feet of merchantable pine (board measure) standing May 31, 1880, in these States, together with the number of feet cut during the census year ending with that date:

States.	Standing pine. Feet.	Cut census year 1880. Feet.
Texas........................	67,508,300,000	174,440,000
Wisconsin....................	41,000,000,000	2,007,559,000
Michigan.....................	35,000,000,000	4,397,211,000
Mississippi..................	23,975,000,000	115,775,000
Alabama......................	21,192,000,000	245,396,000
Florida......................	6,615,000,000	208,058,000
Minnesota....................	8,100,000,000	540,977,000

Probably future bulletins will give the extent of pine land in other States as well as statistics relative to the supply of valuable timber of other kinds, but the above figures show (first) that the pine States in the South contain the greatest amount of timber, and (second) that the pine in Northern States is being cut much more rapidly than in the South. At the rate of the cutting of 1880, without making allowance for the increase by growth, Wisconsin's supply will last less than twenty years; Michigan's seven years, and Minnesota's less than twelve years. At this rate the South must furnish the greater part of the pine lumber in 1890.

CONTRACT AND SPECIFICATIONS FOR THE CONSTRUCTION OF THE YOUGHIOGHENY BRIDGE, McKEESPORT, PA.

Continued from Page 55.

masonry shall not exceed two hundred (200) pounds per square inch.

36. *Friction Rollers.*—All spans except trestle spans shall have at one end nests of turned friction rollers formed of wrought iron, running between planed surfaces. The rollers shall not be less than two and one-half (2½) inches in diameter, and shall be so proportioned that the pressure per lineal inch of rollers shall not exceed the product of the square root of the diameter of the roller in inches multiplied by five hundred (500) pounds (500 $\sqrt{d}$). Trestle spans to have expansion provided for at ends of the plate girders.

37. *Camber.*—The camber for the ninety (90) feet spans to be one (1) inch; for the two hundred and thirty-six (236) feet span, three (3) inches, and for the one hundred and thirty-seven (137) feet six (6) inch spans, two (2) inches.

QUALITY OF IRON.

1. All wrought iron must be tough, fibrous and uniform in character. It shall have a limit of elasticity of not less than twenty-six thousand (26,000) pounds per square inch; a variation of one-thousandth ($\frac{1}{1000}$) of an inch per foot will be considered a permanent set.

2. Finished bars must be thoroughly welded during the rolling, and free from injurious seams, blisters, buckles, cinder spots or imperfect edges.

3. For all tension members, the muck bars shall be rolled into flats and again cut, piled, reheated and rolled into finished sizes. They shall stand the following tests:

4. *Tension Tests.*—Full-sized pieces of flat, round or square iron, not over four and one-half (4½) inches in sectional area, shall have an ultimate strength of not less than fifty thousand (50,000) pounds per square inch, and stretch twelve and one-half (12½) per cent. in their whole length. Bars of a larger sectional area than four and one-half (4½) square inches, when tested in the usual way, will be allowed a reduction of one thousand (1000) pounds per square inch, for each additional square inch of section, down to a minimum of forty-six thousand (46,000) pounds per square inch.

5. When tested in specimens of uniform sectional area of at least one-half (½) square inch for a distance of ten (10) inches, taken from tension members which have been rolled to a section not more than four and one-half (4½) square inches, the iron shall show an ultimate strength of not less than fifty-two thousand (52,000) pounds per square inch and stretch eighteen (18) per cent. in a distance of eight (8) inches.

Specimens taken from bars of a larger cross section than four and one-half (4½) inches will be allowed a reduction of five hundred (500) pounds for each additional square inch of section down to a minimum of fifty thousand (50,000) pounds.

6. The same-sized specimen taken from an *angle* and other shaped iron shall have an ultimate strength of not less than fifty thousand (50,000) pounds per square inch, and elongate fifteen (15) per cent. in eight (8) inches.

7. The same sized specimen taken from *plate* iron shall have an ultimate strength of not less than forty-eight thousand (48,000) pounds per square inch, and elongate fifteen (15) per cent. in eight (8) inches.

8. *Bending Tests.*—All iron for tension members must bend cold for about ninety (90) degrees to a curve whose diameter is not over twice the thickness of the piece, without cracking. At least one sample in three must bend one hundred and eighty (180) degrees to this curve without cracking. When nicked on one side, and bent by a blow from a sledge, the fracture must be nearly all fibrous showing, but few crystalline specks.

9. Specimens from *angle, plate* and *shaped* iron must stand bending cold through ninety (90) degrees, and to a curve whose diameter is not over three (3) times its thickness without cracking, when nicked or bent its fracture must be mostly fibrous.

10. *Rivets and Pins.*—Rivets and pins must be made from the best double refined iron.

11. *Cast Iron.*—The cast iron must be of the best quality of soft gray iron.

Tests and Inspection.—All facilities for inspection of iron and workmanship shall be furnished by the contractor. He shall furnish, without charge, such specimens (prepared), of the several kinds of iron to be used as may be required to determine their character.

13. Full-sized parts of the structure may be tested at the option of the chief engineer, but if tested to destruction such material shall be paid for at cost, less its scrap value, to the contractor, if it proves satisfactory. If it does not stand the specified tests, it will be considered rejected material, and be solely at the cost of the contractor.

WORKMANSHIP.

1. All workmanship shall be first-class in every particular.

2. Abutting joints in truss bridges [illegible] exact contact throughout.

3. Bars which are to be placed side by side in the structure shall be bored at the same temperature, and of such equal length, that upon being piled on one another the pins shall pass through the holes at both ends without driving.

4. Whenever necessary for the protection of the thread, provision shall be made for the use of pilot nuts in erection.

PAINTING.

1. All work shall be painted at the shop with one good coat of selected iron ore paint and pure linseed oil.

2. In riveted work, all surfaces coming in contact shall be painted before being riveted together. Bed plates, and all parts of the work which will not be accessible for painting after erection, shall have two coats of paint.

3. Pins, bored pin holes and turned friction rollers shall be coated with white lead and tallow before being shipped from the shop.

4. After the structure is erected, the iron work shall be thoroughly and evenly painted with two additional coats of paint, mixed with pure linseed oil, of such color as may be directed, the tension members being, however, generally, of lighter color than the compression members.

FINAL TEST.

1. Before the final estimate is made, a thorough test of the structure will be made by the chief engineer, by loading each span with the previously stated rolling load at a speed, approximately, of fifteen (15) miles per hour, and also by causing the load to remain on each span an hour or more.

2. Each span must not deflect under such strains more than one-half the camber above mentioned, and no permanent change shall take place in the whole or any part of the structure.

3. The final test will be as follows: A train made up of two (2) consolidation engines and followed by a train weighing one gross ton per foot, running at a speed of fifteen (15) miles per hour. Air or hand brakes may be applied to engines and cars when on any part of any span.

GENERAL CONDITIONS.

1. Inspectors appointed by the chief engineer of * * * will inspect the materials at the mills, supervise all work while in progress at the shops and erection at bridge sites, and all tests to be made.

2. All facilities for examining the stock and methods of manufacture shall be offered the inspectors. They shall be kept duly posted during the different stages of the work, and notified ahead whenever the iron is to be rolled and shipped.

3. All parts of the structure must be inspected and stamped by an inspector before shipment is made.

4. The contractor will be required to make good, at his own expense, any defect discovered at any time before the final payment is made, notwithstanding previous inspection and approval, unless the attention of the inspector shall have been previously called to such defect, and his allowance of it obtained in writing.

5. The said * * * shall not be held responsible for any delay of work caused by the rejection of materials or workmanship of detailed or finished parts of the structure, when such rejection is due to a violation of these Specifications or Conditions.

6. Contractors will submit with their proposals a full set of drawings (in large scale on sheets, size 23 × 31 inches), showing all the parts of the structure as they propose to erect it, giving sufficient information that an intelligent idea can be formed of all the minute details of the same; and as soon after as possible (not exceeding sixty (60) days), after said proposal is accepted and contract entered into, a full set of strain sheets, general and detail drawings or plans, showing the details of each part of the structure, must be submitted to the Chief Engineer for his acceptance and approval; and at all times during the progress of the work the Contractor must be prepared to furnish the Chief Engineer with such plans, drawings and strain sheets of the structure as he may require.

7. No work shall be commenced on any part of the structure until plans of said work shall have the signature of the Chief Engineer thereon.

8. Contractors in submitting their proposals must give the distance required from the base of rail to the top of coping of each pier and abutment.

9. AND THE SAID * * * doth promise and agree to pay the said * * * or completing the work provided for in this contract in accordance with the specifications and conditions herein set forth, and to the satisfaction and acceptance of the Chief Engineer * * *

10. On or about the first day of each month during the progress of this work, an estimate shall be made, under and by the directions of the Chief Engineer, of all the material delivered at the bridge site that is to form part of the structure and of all the material put in place in the structure during the previous month; a certain price will be paid for cast iron, wrought iron and timber at the site, and for cast iron, wrought iron and timber in place; before any price is determined upon the contractor shall furnish to the Chief Engineer a detailed statement showing the weight of iron or feet board measure of timber in every member of the structure and the total weight of iron and amount of timber in the structure, and from said statement the Chief Engineer will determine the prices at which said cast iron, wrought iron and timber shall be estimated, and [illegible] certificate of the amount being presented to [illegible] said * * * or such disbursing [illegible] * * * may appoint * * * per centum of the [illegible] of said estimate shall be paid to said * * * [illegible] or before the * * * day of each calendar month; and when all the work embraced in this contract is completed agreeably to the specifications and in accordance with the direction and to the satisfaction and acceptance of the Chief Engineer, there shall be made a final estimate of said work agreeably to the terms of this contract, when the balance appearing due to the * * * shall be paid to * * * upon * * * giving to said * * * a release under * * * hand and seal, releasing and discharging * * * from any and all claim and demand whatsoever in any manner growing out of this contract, and any and all cost, charge and expense connected therewith.

11. All materials that have been estimated and paid for, as aforesaid, are hereby declared to become the property of said * * *, but all such materials are in the charge of the contractor, and are entirely at the risk of the contractor; and said * * * shall in no way be held liable or responsible for any injuries to men, or to said materials, from fire, floods, collisions, or loss by decay or otherwise, during the manufacture, transportation or erection of said structure, until the work shall have been completed and accepted by the Chief Engineer.

12. The contractor shall conduct all his operations so as not to obstruct the navigation of the river.

13. The contractor shall furnish all staging, scaffolding and false work, and adjust all the work complete.

14. The within contract, specifications and prices are intended to cover all the work required for the complete finishing, as herein set forth, of all the superstructure of * * * as aforesaid; and under no circumstances shall any extra work or price be allowed; provided, however, if in any contingency the contractor should be required to do any work or furnish any materials which, in the opinion of the chief engineer, are not provided for in the contract, specifications or prices herein set forth, such work shall be done and such materials shall be furnished only upon a written order of the chief engineer, which order shall specifically set forth the work to be done or the materials to be furnished, the manner and time in which said work shall be done, and the prices for said work and materials.

15. The said * * * reserves the right to secure itself from all liability that might arise from the failure of the contractor to pay any and all claims whatsoever for which the said * * * would be legally liable. And the said * * * shall have the right to pay said claims and deduct the amount from any monthly estimate or estimates, and retain sufficient funds from any retained percentages for that purpose until the said * * * is satisfied that the said claims are paid.

16. The work embraced in this contract shall be carried on in such a manner and prosecuted with such rapidity as the Chief Engineer shall deem adequate for its completion within the time herein specified; and if at any time the contractor shall refuse or neglect to prosecute the work with energy sufficient, in the opinion of the Chief Engineer, for its completion within the time specified in this contract, then and in that case the Chief Engineer shall have the right to declare this contract, or any portion of the same, forfeited and void; and said * * * shall have the right to go on and complete said work, or any portion of the same, in such manner as * * * may deem best, and pay such prices or amounts of money as may be required for its completion in accordance with the contract and specifications herein; and said contractor shall be responsible and liable, and hereby agrees to pay to said * * * all sums of money which said * * * may have to pay for the completion of said work, as aforesaid, over and above the contract price or prices herein set forth for its completion by said contractor.

17. And it is mutually agreed and distinctly understood that the decision of the Chief Engineer shall be final and conclusive in any dispute which may arise between the parties to this contract relative to or touching the same, or touching the quality, quantity or value of any work done under this contract; and each and every of said parties do hereby waive any right of action, suit or suits, or other remedy in law or otherwise, by virtue of said covenants, so that the decision of said Chief Engineer shall, in the nature of an award, be final and conclusive on the rights and claims of said parties hereto.

18. Wherever the words Chief Engineer or pronouns relating to the same are used in this contract or specifications herein, it is understood to mean the Chief Engineer of said * * * whose orders, directions or instructions may be given in person or through such assistants or inspectors as he may appoint. Wherever the word Contractor or pronouns relating to the same is used in this contract or specifications herein, it is understood to mean * * *

In Witness Whereof, the parties hereto, do execute this Contract, dated the day and year first [illegible] written.

[illegible] this bridge are to be addressed to J. [illegible] Chief Engineer Pittsburgh, McKeesport [illegible] Railroad, 77 Fourth avenue Pitts[illegible] to be in by March 1 next.]

L[illegible]

THE ACTUAL [illegible] OF EA[illegible]

BY B. BAKER, M. INST. [illegible], LONDON.

(No. 56, Van Nostrand's [illegible] Series.)

This valuable collection of experiments, or rather experiences, the result of observations gathered during the construction of some 48 miles in length of retaining walls of all kinds, under all circumstances of location and variety of foundation, is worth volumes of algebraic formulæ deduced from insufficient data derived from office experiments on a small scale, which at best can but give vague results and unsafe guides for practice.

In the discussion which followed the reading of this paper before the British Institute of Civil Engineers, it was suggested as a better title for the paper, "The Stability of Retaining Walls," as the scope of the paper developed the anomalous failure of heavy walls and the permanency of lighter structures, under apparently similar conditions, rendering the lateral pressure of the earth an unknown factor in either case, notwithstanding the care taken in the selection of formulæ expressive of it from the best existing authorities. He says, "Something must be assumed in any event, and it is far more simple and direct to assume at once the thickness of the wall than to derive the latter from equations based upon a number of uncertain assumptions as to the bearing power of the foundations, the resistance to sliding and other elements." "It has often struck the author that the numerous published tables giving the calculated required thickness of retaining walls to their places or decimals stand really on exactly the same scientific basis, and have the same practical value, as the weather forecasts for the year in old Moore's Almanack," or, as one of our old engineers is accustomed to characterize it, "guessing at half and multiplying it by two." He states as a significant fact "that, out of nine miles of retaining wall on the underground railway in London, the exceptionally weak wall should show, as it did, no movement, either during or after construction, while the exceptionally strong wall, though having six times the estimated stability of the former, should fail," and adds his convictions that the laws governing the lateral pressure of earthwork are not at present satisfactorily formulated.

The numerous examples of walls as built, given in this small volume, and their behavior, are very instructive, and our young mathematicians who know all about the thing would do well to carefully read this book before committing themselves to the accuracy of their differential calculus based upon insufficient data.

CORRESPONDENCE.

UNIFORM CONVENTIONAL TINTS.

RUTGERS COLLEGE, NEW BRUNSWICK, N. J.,
Feb. 11, 1882.

EDITOR ENGINEERING NEWS:

Have you in use at your institution a set of conventional tints for representing the various materials employed in mechanical, architectural and civil engineering constructions, as they have, for instance, at the Ecole Centrale des Arts et Manufactures at Paris? If so, will you please indicate them to me, and are they satisfactory?

The present confusion of tints in the practice of engineers, etc., in the books and in the schools is, at the least, unfortunate. Cannot this be remedied in time and is not the proper place to begin in the schools of engineering? If these can agree upon and adopt a set of tints by correspondence or in convention the beginning will have been made. Will you unite in such a movement? At present I use the tints adopted at the Ecole Centrale.

Very truly, ISAAC E. HASBROUCK.
Professor Mathematics and Graphics.

[We will be pleased to render such service as we can in the above matter.—EDITOR ENGINEERING NEWS.]

SEWERAGE OF EUROPEAN CITIES.*

PARIS.

Population.—In 1880, 2,100,000; average density, 96 persons to 1 acre; the old city has as many as 818 to 1 acre; the outer districts, Gobelins and Observatoire, 45 and 61, respectively, per acre.

Area.—Inside of fortifications, 19,281 acres; circumference, 32,830 meters, or over 20 miles; greatest breadth from north to south, 5½ miles; greatest breadth from east to west, 7 miles; areas covered by public streets, 3,706 acres; areas covered by rivers or quays, 1,087 acres; areas covered by cemeteries, 222 acres; houses, parks and gardens, 14,268 areas.

Dwellings.—Number of private houses, 74,740, containing 685,900 dwelling-rooms and 337,600 shops and work-rooms. Number of inhabitants per house, 30.8.

Water Supply.—Average per day:

	Gallons.
Watering and washing streets	28,713,200
Watering and sprinkling parks	9,477,740
Fountains	10,708,40
Public buildings, hospitals, etc	11,474,720
Private dwellings	33,141,960
Total	93,514,020
Minimum	78,714,000
Maximum	104,000,000

This quantity is divided up as follows:

	Gallons.
Vanne (spring)	29,414,000
Dhuys (spring)	6,603,000
Ourcq (creek)	34,348,000
Marne (river)	13,207,000
Artesian wells	184,800
Seine (river)	23,771,700
Supply not sufficient; it is desired to have	132,000,000
Present average, per head	50.2
Present average, per head, of spring water (Vanne and Dhuys)	15.0

which is intended for house supply only.

Mortality mean for ten years, 23.9. In VII Arrondissement (Elysée) it is 14.0. In XII Arrondissement (Gobelins) and XIV (Observatoire) 39.0.

Meteorological temperature:

	Fahrenheit.
Sixty years mean	+51.44
Highest known temperature, Aug. 26, 1765	+101.00
Lowest known temperature, Jan. 25, 1795	−10.30
Mean of yearly maximum for 100 years	+91.22
Mean of yearly minimum for the years	+14.30
During last 90 years average number of days in a year when the thermometer was below freezing	40.5
During last 90 years average number of consecutive days of frost per year	14.4
Depth of frost: Mean, 8 in.; maximum, 31 in.	
Rain:	
Mean annual, inches	23
Minimum annual, in 1793, inches	8
Maximum annual, in 1804, inches	27¾
Average number of days per year when rain falls is	151
Mean humidity	69.0

Maximum rain storms: In summer often ⅝ in. fall per hour.

1860, July 16, 38 millimeters in 20 minutes = .0750 in. per minute.

1865, May 23, 26 millimeters in 20 minutes = .0520 in. per minute.

1866, July 16, 32 millimeters in 30 minutes = .0424 in. per minute.

1867, Sept. 10, 41 millimeters in 20 minutes = .0810 in. per minute.

1870, May 22, 26 millimeters in 60 minutes = .0172 in. per minute.

1872, July 27, 40 millimeters in 60 minutes = .0263 in. per minute.

1876, Aug. 13, 16.3 millimeters in 40 minutes = .0164 in. per minute.

Prevailing winds, southwest.

Topographical.—Altitude of the Seine at Paris is 80.5 ft. above the sea. No part of the city is flooded by high water; both shores have stone embankments through the city. Fall of river at low water when discharge was 1,695 cubic ft. per second: for eastern extremity of Paris, 1:19,488; for center of Paris, 1:1213; for western extremity of Paris, 1:14,225. Flood discharge March, 1876 (highest), was 56,500 cubic ft. per second.

Physical.—Older part of the city is very closely built up, especially towards the north and south. The western part has broad streets, avenues, parks, etc. Length of streets, boulevards, etc., is: with trees, 136 miles; without, 415 miles.

Management of Public Works.

All public works are under control of an inspector-general and director, with a general office and corps of 26 persons. The main departments, each one of which has a chief engineer and a large corps of assistants, are as follows:

I. *Streets.*—For the general design and laying out of the city, its streets, parks, &c.; also for the registry of real estate property; also for the construction and cleaning of streets. Corps: 45 persons for design and registry; 314 persons for supervision, construction and maintenance.

II. *Lighting the City.*—Corps: 50 persons for design, construction and supervision.

III. *Parks and Boulevards* (landscape gardening).—Corps: 165 persons for design and maintenance.

IV. *Water Supply and Sewerage.*—Corps for general offices: 211 persons for design, construction and maintenance.

a. Water-supply: Chief engineer and corps.

b. Sewers, canals and sewage farm: Chief engineer, consulting engineer and corps for general work; special engineer for construction and maintenance of sewers and nightsoil service, with corps; special engineer for disposal of sewage and nightsoil, with corps.

V. *Tramways.*—For construction and service of passenger railways of the city.

VI. *Architecture.*—For construction and maintenance of all public buildings: 18 consulting architects, 12 regular architects, 60 inspectors, etc.

Paris Budget for 1881.—Ordinary expenses:

		Francs.
Interest on municipal debt, etc		80,368,308
Police		22,823,508
Public schools		15,343,118
Public charities and pensions		16,202,973
Contribution for maintenance of army		2,014,800
Interments		1,135,308
Public Works:		
General office	1,717,000	
Architecture and fine arts	4,667,700	
Public highways	22,312,050	
Promenades and lighting	8,904,080	
Water and sewer department	11,446,460	
		49,047,290
Other expenses		22,883,088
Total		229,095,453
Extraordinary Expenses:		
New streets and pavements		2,480,000
New buildings		3,960,000
Other expenses		4,010,000
Grand total		237,395,453
		or $47,479,091

Design and Construction of Sewerage Works.

General System and Alignment.—Transitional state at present. Four-fifths of all excrementitious matter is collected in water-tight vaults (fosses fixes) or in movable casks (fosses mobiles) and is periodically removed to a distant locality. The remaining quantity, which is increasing, is collected in casks (fosses filtres) which retain solids but permit liquids to escape and flow into sewers. They are exchanged at less frequent intervals and their contents disposed of in a similar way. All waste water from houses and streets, together with rain, are carried into a system of sewers. Its extent, as a uniform system throughout, excels that of any other city. Paris is divided into three main drainage-areas from which the sewage is carried entirely out of the city, and each one of which has a main collecting or intercepting sewage (collecteur général). Besides these main collectors there are about 16 secondary ones discharging into them. The remaining are the "ordinary" sewers. In all streets above 65.5 ft. in breadth double lines of sewers are built, one under each sidewalk, and in narrower streets they are built in the center. The ordinary sewers follow the valley lines as much as possible, and are all large enough to be walked through. No pipe sewers are used. The entire system was designed by M. Belgrand.

Shape and Size of Sewers.—The smaller or ordinary sewers have a shape approaching the oval, but with a flat, segmental invert, varying from 16 to 24 in. in width. The larger sewers or collectors have a banquette on one or both of the sides of the invert (cunette) high enough to be above the ordinary flow and broad enough to be walked upon. The main collectors have an invert about 11 ft. wide and 4½ ft. deep, in which specially constructed cleaning boats (bateaux vannes) are floated. The secondary collectors have inverts 47¼ in. wide and 31 in. deep, with iron rails at their edges upon which the cleaning-trucks are run. The arches of the sewers covering the invert (cunette) and banquettes are semi-circular. All sewers are built large enough for men to walk upright in them, even the house branches, which extend to the point where the vertical soil and other pipes descend. Pipes for the water supply, pneumatic tubes and telegraph wires are inside of the sewer and attached to the arch. When the grades are small, the type is determined through the following formula, which is derived from Prony's formula: Mean radius × slope = coeff. × square of velocity, and the assumption that the greatest quantity of rain falling in Paris is 1.77 in. per hour and the time to reach the sewers is three times longer than the duration of the rain.

A = drainage area; a = section of sewer; r = main radius; s = fall per 1,000, all in metric measure; $a = \frac{0.0239 A}{\sqrt{rs}}$.

When storm-water overflows can be had, proper allowance is made when using this formula.

Depths and Grades.—The depth of the ordinary sewers, unless grade demands it otherwise, is regulated so that they get a covering of at least 20 in., which brings their inverts at least 6 ft. below the surface. The depth of the invert (cunette) is at least 1 meter for the types cleaned by boats and at least 31½ in. for those cleaned by the tracks. The grade of the ordinary sewers is generally the same as that of the street; it is often rather steep. The large collectors are very flat, and are not self-cleaning owing to the large amount of silt which is washed into them from the street. Types 1 and 3, which are cleaned by boats, have a fall from .0003 to .0005. The ordinary grade for house branches is 0.03.

Junctions, Connections, Overflows, Outfalls.—The junctions of large sewers are not made in the English or Frankfort manner, but are as a rule rectangular chambers with cylindrical arch. Whenever possible an extra fall is to be given at every junction, so that no backwater is caused in the smaller sewer. The grade of large sewers at their junctions is also determined by the necessity of having the banquettes on the same level; the cunette or invert will therefore drop correspondingly. When two oval sewers join, a drop of 8 to 12 in. is given, if possible, to each. The highest ends of the sewers are placed as little below the surface as allowable. The house branches, at least 1 meter high, connect with the sewers generally at right angles, which does not seem objectionable, as the house sewage is usually brought to the main in terra-cotta pipes, bedded in the invert of the branch and discharged from a trap basin (cuvette). These pipes receive the house water and the fluid excrements of the "fosses filtres" where these are used. The branches from the sewer extend under the sidewalk and often under the houses to the back yards. Storm water overflows are placed along the river at a few places. There are three outfalls for the Paris sewage, one at Clichy, one at St. Ouen, and one at St. Denis, all on the banks of the Seine several miles below Paris. The outfall at St. Ouen is at an elevation to allow the sewage to run by gravity to the irrigation fields of Gennevilliers. The sewage from the lower areas discharges at Clichy at ordinary high-water level and its contents are now partially being pumped to Asnières, Gennevilliers, etc. Arrangements are being made to pump all of the sewage in the future.

Ventilation.—The Paris sewers are ventilated through the street-gullies and the outfalls, and occasionally through pipes terminating at roofs of buildings. No objectionable odor arises from the gullies into the street, nor is there much smell in the sewers, except from some irregularity, which is quickly removed.

Man-holes.—Man-holes (branchements de regard) are always entered on the side-walks, through side entrances to the sewer, never from the street. They are closed with a cast-iron cover, 2 ft. 7½ in. in diameter, and are descended by iron steps, fixed in the wall every foot. The floor of the side entrances is ordinarily, 1 ft. above the invert of the sewer, and slopes toward it with a grade of 0.015. Sometimes, in large sewers, carrying much water, stone steps are built instead. The height of the passage way is 6 ft. 7 in., its width at spring is 39 in., at bottom, 20 in. Man-holes are, generally, 164 ft. apart, which is not varied from, except when near a sidewalk crossing.

Gullies (street basins).—Gullies (branchements de bouche) have side openings in the curbs 39 in. long and 4 in. to 5 in. high in the center and 2 in. at the sides. Gullies are built at no regular distance. The flatter the grade the more frequently they are placed. They are not located at street corners, but in the block.

Pumping Station.—The pumping station is situated at Clichy, near the bridge crossing the Seine to Asnières. Its capacity is gradually being extended to correspond with the extension of the irrigation fields. The present works provide for only one-sixth of the sewage. There are two horizontal engines, one of 250 horse-power, the other of 150 horse-power. The larger engine raises 1,040,000 gallons per hour, in a day of 15 hours, at a cost of 52 cents per 1,000 gallons raised 36 ft., with coal costing $6.30 a ton.

Miscellaneous Structures.—The sewage crosses from the south to the north side of the Seine by an inverted siphon near the Pont de l'Alma. It is a double line of wrought-iron tubes each 1 meter diameter (39½ in.), 556½ ft. long, laid several meters below bottom of river. The head upon the siphons can be varied from 1.7 ft. to 7.8 ft. as it becomes necessary. No trouble has been experienced with it.

Materials and Construction.—Sewers are built of boulders of a coarse, gritty sandstone (*meulière*), found in neighboring diluvium. Lately, some have been built of concrete. Bricks are rarely used. Vitrified pipes are only used for house drainage. The *meulière* masonry, bedded at right angles to the inner surface, is plastered with rich Portland cement mortar to an exceedingly smooth and regular surface. The coating must have a thickness of at least ⅜ in. over the most projecting points of the masonry. The least thickness of coating of the invert and banquettes must be 1⅛ in.; the coating of the extrados of the arch must be ⅜-in. The stones form only about 50 per cent. of the bulk of the masonry, and are intended to act rather as stones forming a concrete than to give much strength in themselves. The underground sewage carriers in Gennevilliers are built entirely of concrete: their strength is tested to a head of 26 ft. of water. The material is composed of 3 parts cement and 5 parts clean gravel and 5 parts sand in volume. The concrete sewers are partially moulded in the trench, and partially molded at the works and joined in the trench. The walls of street inlets and other appurtenances are also built of *meulière* boulders, plastered to a smooth surface. Over the extrados of sewers the earth filling is generally 40 in., in exceptional cases it is 20 in. in streets and 5 in. on the sidewalks.

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* From Mr. Rudolph Hering's report to the National Board of Health.

Statistics.

Area drained by main sewers, acres	15,609
Length of sewers in 1880:	
Main and intercepting (collecteurs), miles	45
Branch (ordinaires), miles	348
Total, miles	393
Number of gullies	7,877
Length of gully connections, miles	25¼
Number of man-holes	10,093
Length of man-hole side entrances, miles	14¼
Length of house connections, miles	87
Usual length of branches to gullies or man-holes, ft.	8 to 9
Length of sewers necessary to complete system, miles	261
The least grade of street gutters is	0.005

In Houses.

Various methods of removal are practiced. A large number of houses have water-tight cess pools, from which the contents are removed by odorless excavators and taken to various establishments for utilization.

Another method is to collect the night-soil in movable casks (*fosses mobiles*), which receive solids and fluids as well, and which are exchanged at intervals varying from a few days to a few weeks. Their contents are taken to the same establishments.

A third method, the one which at present receives the indorsement of the city authorities, is to receive the night-soil into movable casks which permit the liquids to drain off (*appareils diviseurs* or *tinettes filtres*) and run into the sewers or cesspools. The retained solids therefore need a much less frequent removal (average 24 times a year), and are finally disposed of as before. The casks stand generally in the house branches or passageways accessible from the sewers, or where none have been built, in vaults.

Number of cess-pools, holding each about 4 cubic yards	86,000
Number of movable receptacles:	
Retaining both solids and fluids	17,450
Filtering liquids into sewers	13,000
Filtering liquids into old cesspools	10,000
	126,450
Number of houses connected with sewer by a passage way or branch	25,298
By pipes	1,050
Number of houses having night-soil service	63,000
Daily amount of sewage discharged, cubic feet	9,288,165
Daily amount of night soil removed, cubic yards	2,150
Amount from tinettes alone, cubic yards	302

Since July 2, 1879, it is lawful for small houses to be connected with the sewers by iron or vitrified pipes 12 in. in diameter, with a least slope of .075, except in streets where travel is great and where the subsoil is soft and uncertain. Exhaust steam is not allowed to be discharged into the sewers.

Disposal of Sewage.

The night-soil removed from cesspools and in movable casks is disposed of at various points around the city, the most important being the municipal works at La Villette, where three-fifths of the total quantity is taken. Here the casks are placed upon canal boats and towed to Bondy. The night-soil from cesspools is delivered in large casks upon wheels, into which it is pumped at the houses. The contents are dumped into an extensive underground reservoir 108 ft. by 105 ft. by 13 ft. deep, and the liquids, which are about six-sevenths of the mass, including suspended particles, are pumped by a 25 horse-power engine into two iron conduits, 8 in. diameter each, and 10,500 yards long, to Bondy. The deposited solids are then loaded into casks and taken there by boat. The establishment of La Villette is well kept, the cellars are washed daily and are well ventilated. At Bondy the contents of the casks are dumped into basins and allowed to dry. The liquids pumped are also allowed to precipitate any solids, the residue in both cases being manufactured into poudrette. The liquids are distilled, and by the aid of heat and the addition of lime-water the ammonia is disengaged and is converted into sulphate of ammonia. The yield varies from 13 to 20 pounds per cubic yard of liquid. About 885 cubic yards of night-soil are daily taken to these various depotoirs.

The sewage proper of Paris is delivered at three points along the right bank of the Seine, at St. Denis and St. Ouen, where, at the latter place, it has an elevation sufficient to cross the river on a bridge and flow to irrigation farms on the plains of Gennevilliers. At Clichy, it requires pumping and is raised under a head of 30 ft., crosses the river on a bridge to Asnieres, and thence flows to the fields. About 60,000 cubic yards in summer and about 40,000 cubic yards in winter are now pumped daily and utilized. The rest flows into the Seine, which is strongly polluted as far down as Epinay. About 120,000 cubic yards of silt, supposed to be deposited from sewage, are yearly dredged. The sewage is led along roads and paths over the flat and sandy surface of the Gennevilliers district in channels, partially under pressure and partially open. The former are built of concrete, and have valves on the surface from which the sewage can be drawn. The sewage is applied either as broad irrigation (en colmatage) or in furrows (en rigoles) between long narrow beds 3 ft. in width. The latter is preferred. The position of the beds is changed every year, so that they are placed on the furrow of the previous year. The extension of the sewage carriers over the entire peninsula is gradually to be accomplished.

	Acres.
Irrigated surface in 1872	126
Irrigated surface in 1875	346
Irrigated surface in 1878	914
Irrigated surface in 1880	1,050
Area available	12,000
or one acre for 170 to 200 persons.	

No ill effects have been caused by the irrigation works. Since they were started, a new village, Gresillons, has sprung up in the midst of the territory, with a death-rate averaging only from 19.5 to 25.3. Irrigation was begun in 1869. It is intended in future to purify the sewage more by filtration through the soil than by irrigation alone. The two methods will be combined, however, as much as possible.

Maintenance of Sewerage Works.

1. *Appliances.—a. For Removing Night-Soil.*—Cess pools are cleaned by pumping the contents into cylindrical iron carts with a capacity of from 70 to 140 cu. ft. These, when full, are hermetically sealed and conveyed to the several depots, La Villette, etc., for disposal. The common "fosses mobiles" are strong wooden casks containing from 4 to 6 cu. ft. They are closed with a tight-fitting cover and taken to the depots in carts for disposal. The "tinettes filtres" are made of galvanized sheet-iron of a cylindrical form, 16 in. in diameter and 26 to 29 in. in height, with a movable screen to separate the fluids from the solids. They are connected by a movable bayonet-joint with the soil-pipe and by a small movable india-rubber pipe with the branch from the sewer. They can thus be readily removed, and after being tightly closed are rolled under a man-hole, hauled up, placed upon a cart and taken to the depots for disposal.

b. For Cleaning Sewers.—The appliances are as follows:

The "bateau-vanne" is a boat with a movable apron or scraper (vanne) of the shape of the invert, but an inch or two smaller, perforated with three small openings and suspended at the bow so that it can be raised or lowered. When it is lowered to within a small distance of the bottom the water rises behind it, and, besides propelling the boat, rushes with great velocity through the narrow opening and stirs up the sediment. This sediment, as it accumulates in front of the apron, is pushed forward by it through the rising head of water and thus brought to the outlet. It is used in types Nos. 1 and 3.

The "wagon à bascule," or tip-wagon, is a truck, into which the silt is thrown and carried to the outlet. The "wagon-vanne" is a truck running on rails about 4 ft. apart, and fastened to the edge of the "piedroit" (path). It operates exactly like the boat, in having a movable apron in front, by which the detritus is pushed down the sewer.

The "wagon ordinaires," are simple trucks for the sewers of an oval shape. The siphon crossing under the Seine at the pont d'Alma is cleaned by means of a ball of hard wood 53½ in. diameter, 5.9 in. less than diameter of pipe, and weighing 187 lbs., which is passed through it at intervals, generally once a week. It is pushed along by the force of the water, and by being lighter it rolls along the soffit, which increases the velocity of the water along the bottom and causes the sediment to be scoured up and moved toward the outlet. It has been in use many years and given no trouble nor reason to anticipate any. There is a difference of level between the two ends of 1 ft. 8 in., and this difference can be increased to nearly 7 ft. by damming up the water at the southern end. A great velocity for simple flushing and for passing the ball is thus obtained. After the ball is inserted at one end it requires generally but a few minutes to appear at the other, pushing the silt in front of it. With a head of 1 ft. 8 in. its velocity is about 3 ft. per second.

The condition of the sewers is generally clean and no strong, disagreeable odor prevails except in the sewer which brings the foul waters from the Bondy establishment. During the summer months visitors are weekly taken through the large collectors in a cleaning-boat.

Cost of Sewerage Works.

Management and Maintenance.—Department for sewerage in 1879:

Corps for design and construction	$193,936
Materials and labor (exclusive of new work)	973,900
146 persons for inspection of cleaning sewers and night-soil service	71,000
Extension and repairs to city sewerage	420,000
Construction of house branches	28,000
Maintenance of sewers:	
Public sewers, flushing, etc	243,200
House brances (reimbursed to city)	76,000
Public buildings, including night-soil removal	45,400
Dredging sludge from river	36,000
Miscellaneous	20,400
	$421,000
Utilization of sewage at Gennevilliers	76,000

Department for water supply in 1879:

Total expense, 5,860,280 francs=$1,172,056.

Annual cost of cleaning sewers per head of total population, 12.5 cents.

Annual cost of pumping sewage per head of total population, 4.5 cents, or about one centime for one cubic meter pumped.

Annual cost of night-soil service per head of population, 55 cents, or $1.28 per cubic yard.

Annual cost of pumping night-soil to Bondy, 2.92 cents per cubic yard.

Annual cost of transporting casks to Bondy, 7.32 cents per cubic yard.

Soil-pipes in houses supplied with the filtering casks are taxed with $6 annually. The removal and exchange of one cask is charged to owners with 30 cents. There is an average of 6.3 exchanges per annum. Therefore annual cost is about $1.90. Proprietors pay for the construction of house branches. Cost of the sewage purification works from 1869 to 1880 was about $600,000. Cost of maintenance and studies up to 1880 was about $600,000.

Rent of ground before sewage irrigation (1868) per acre		$12.15
Rent of ground after irrigation:		
1872	per acre	12.80
1875	per acre	17.28
1877	per acre	24.00
1880	per acre	36.00

Construction.—Estimated cost of existing sewers is $20,000,000, including 355 miles of main and branch sewers and 123 miles of house branches.

Estimated cost to complete the system is $8,911,100.

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ANNUAL REPORT OF THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.

JAN. 17, 1882

ADDRESS OF THE RETIRING PRESIDENT.

To the Members of the Engineers' Association of Western Pennsylvania:

GENTLEMEN: It is a matter of real regret that I am obliged to be absent from our annual meeting.

In reviewing the past year I see nothing but encouragement for the future.

The attendance at the meetings, averaging 46, is very remarkable, and shows a sustained interest in our proceedings which I believe is not equaled by any society in the country. A monthly attendance of over twenty per cent. of our whole membership shows a lively interest which simply means that our Society is a grand success and that it has filled a great want in our busy community.

I can say without flattery that in the last two years I have frequently wondered where all of the members came from and why they came together.

This only shows that the great growth of our city has not been properly realized by the natives, and that the need of friendly intercourse has in consequence not been provided for.

It is a matter of sincere congratulation that in the two years of our existence we have never had a meeting without a paper, and generally a good one, and sometimes very good ones; also that we have never incurred any debt, and that we now have a balance in the treasury which will justify the incoming board in having our Transactions printed in a little better form than before.

To be out of debt is to be successful, and I have no doubt that the new board will manage as carefully in this respect as has the old one.

A library of some 300 volumes of carefully-selected technical works, all paid for, is no mean achievement, and your library committee, now to be replaced by a permanent committee, deserves your regard for the large amount of work and care they have given to the selection of these books.

The reports of the secretary, the treasurer and the Committees on Library and Tests will give you full information of the details of the work of the year.

It is a pleasant duty to bear testimony to the zeal, industry and care which have been used by the Secretary and Treasurer in conducting your affairs, and I feel it to be especially due to your Secretary, who has added to his ordinary duties those of librarian and secretary of the general committees. To his unremitting attention, care as to details and exactness in records, is largely due the success of the Society, the smooth running of its machinery and the general good condition of your affairs.

The Board of Direction has met frequently and has considered all of the business of the Society with great care, and the proof of this is in results; everything has been well done, and we "owe no man anything but to love one another," and here is your greatest achievement: you have organized, held your meetings, pursued steadily the objects of the Society; many friendships have been formed; questions have been discussed freely and fully, and not one word of discord has entered our councils either in public or private.

Gentlemen: This is better than wealth or glory. In retiring to the ranks of private membership I do not know how to thank you for the unvarying kindness and courtesy with which I have been treated, I can only commend my successor to the same good will and indulgence, and I can only add that I mean to still be with the Society and to work with all my might to make things as lively as possible, so that our worthy "God love" may never have a chance to go to sleep, and that we may all remain alert to our mutual interests is the best wish of Your "retiring president,"

WM. METCALF.

The Treasurer, Albert E. Frost, reports total receipts for the year ending Jan. 17, $1,058, and expenditures $865.12; for the Library Fund, receipts $1,500, and expenditures $1,290.07, leaving a balance of $209.83, to which is to be added a donation, not yet collected, amounting to $500, giving to that for Library $709.83.

To the Board of Direction of the Engineers' Society of Western Pennsylvania:

GENTLEMEN: I take pleasure in presenting my annual report for the year ending Jan. 17, 1882. The past year, the second since the organization of the Society, has been a very successful one. At the time of my last annual report there were 190 names on the list of members, to which there has been added 57, making a total of 247. During the year two have died and 24 have resigned, leaving now on the list 221, or a net gain of 31. During the year the Society has held nine regular and one adjourned meeting. The dates of the meetings, with the membership and attendance, are as follows:

		Membership.	Present.
January	18, 1881	194	53
February	22, 1881	198	42
March	15, 1881	206	80
April	19, 1881	221	61
May	17, 1881	227	54
Septem.	20, 1881	236	14
Septem.	27, 1881	236	20
October	18, 1881	237	38
Novem.	15, 1881	239	45
Decem.	20, 1881	244	55
Total			462
Average attendance			46

The following papers have been read during the year:

Feb. 22, Notes of a Trip Through the James River Valley. By Mr. Jos. D. Weeks.

April 19, Pittsburgh Sewer System. By Geo. H. Brown.

May 17, Discussion of Mr. Brown's Paper.

Sept. 27, Discussion continued.

Oct. 18, Some Wastes of Heat. By Mr. Wm. Metcalf.

Nov. 15, Electricity. By Mr. Jacob Reese.

Dec. 20, an illustrated lecture, by Prof. A. E. Frost, on Radiant Matter.

Description of the Coffer Dam and Means of Puddling at Davis Island Dam. By Mr. William Martin.

The Society, in exchange for its publication, has received the following:

The Committee on Room has continued the arrangements with the Pittsburgh Library Association on the same conditions as for the last year, viz., the Engineers' Society to pay $400 per year to the P. L. A. for the use of a room in which to hold nine monthly meetings, and the members to have the privileges of the library. The P. L. A. have agreed to spend the $400 paid in the purchase of engineering periodicals, but in this they have not fully complied. The following are the papers ordered in this connection at a total cost of about $115; quite a number, however, were on the library tables before any agreement was made between the two societies.

Transactions of the American Society of Civil Engineers for January, February, March, April, May, June, July, August, September and October, 1881.

Journal of the Society of Arts, weekly, from Jan. 1, 1881, to date.

Proceedings of the Engineers' Club of Philadelphia, Vol. II., Nos. 1 and 2, Feb., 1881.

List of Members, Constitution and By-Laws and Papers of the Pi Eta Scientific Society, Troy.

Transaction of the American Institute of Mining Engineers, Oct., 1881.

Proceedings of the Boston Society of Civil Engineers, May, 1881.

Proceedings of the Western Society of Engineers, Feb., 1881.

Abstracts of Papers in Foreign Transactions and Periodicals.

Papers from the Journal of the Franklin Institute.

The American Engineer, December, 1881.

Engineers' Club of Philadelphia.

Journal of the United States Association of Charcoal Iron Workers, August, 1881.

Contributions to the Theory of Blasting or Military Mining, by H. Hofer, Part Second, 1881.

Examples of Structures built by the Keystone Bridge Co., Pittsburgh.

Improvement on Non-tidal Rivers. Col. Wm. E. Merrill.

A large number of specifications of work let in 1881 by the various engineer officers from Maine to California.

Anales de Sociedad Cientifica, Argentina, Buneos Aires for February, March, April, May, June, July, August, September and October, 1881.

Ingeniors Foreignens Forhandlinger, Stockholm, 5 numbers, 1881.

Revistu de Obras Publicas e Minas Publicao Mensal du Associacao Das Enginheiras Civis Portugues, 1881.

1. American Architect and Building News.
2. American Gaslight Journal.
3. American Engineer.
4. Engineering and Mining Journal.
5. Engineering News.
6. Railroad Gazette.
7. Railway Review.
8. Scientific American.
9. Scientific American Supplement.
10. American Journal of Microscopy.
11. American Miller.
12. Bulletin Iron and Steel Association.
13. Carpentering and Building.
14. Eclectic Engineering Magazine.
15. Journal of Chemistry.
16. Journal of Franklin Institute.
17. Manufacturer and Builder.
18. Milling and Mechanical News.
19. Plumber and Sanitary Engineer.
20. Engineer, London.
21. Engineering.
22. Annales des Mines (Bi-Monthly).
23. Annales des Ponts et Chaussées (Monthly).
24. Annalen der Chemie (Monthly).
25. Civil Ingénieur (8 Nos. a year).
26. Journal fur Praktische Chemie.
27. Polytechnisches Journal (Fortnightly).

During the year the Society has been called upon to part with two of its members, by reason of death, viz., Messrs. J. H. Reno and David Carlin. Suitable memorials have been prepared and entered upon the minutes of the Society.

Financially the Society has been a success, as will be seen by the report of the treasurer.

With the surplus on hand the Board expect during the year to publish the papers in a better form.

During the year the Board of Directors have held ten meetings.

Respectfully submitted,

J. H. HARLOW, Sec.

REPORT OF THE LIBRARY COMMITTEE.

Mr. Wm. Metcalf, President Engineers' Society of Western Pennsylvania:

SIR: On behalf of the Committee on Library I have the honor to submit the following report:

As stated in the last annual report of this committee, each one of its members was constituted a sub-committe to prepare a list of books in a special department of technical literature.

Carefully prepared lists were thus obtained, including such works as were considered indispensably necessary for laying the foundations for a library of books upon applied science.

The committee has held a number of meetings, and after a comparison and revision of the lists submitted by its members it was decided to appropriate as follows:

Bridges and structures	$280.00
Railroad engineering	220.00
General natural science	200.00
Metallurgy	300.00
Tests of materials	200.00

Complete sets of the two French periodicals, the "Annales des Mines" and the "Annales des Ponts et Chaussées," have been obtained at a cost of $260.

Bids were obtained of several Eastern publishers and dealers, and the books purchased of the lowest bidder, at a large discount.

A list of the books has been printed and is now in the hands of members. The committee has at all times invited suggestions from members as to the selection of books, but very few suggestions were received.

Following is a statement of the finances:

Donation of Mr. Wm. Thaw	$1,000.00
Donation by a friend of the Society, $1,000, of which there has been received	500.00
Subject to draft	500.00
Total	$2,000.00
Expenditures for books	1,290.17
Leaving a balance of	$709.83

This balance the committee has decided to dispose of as follows:

Chemistry	$300.00	
German Engineering Works	100.00	
Mining Engineering	150.00	
Thermodynamics	50.00	
Hydraulics	50.00	
Leaving still a balance of	$59.83—	$709.83

According to the arrangement entered into with the Pittsburgh Library Association June 15, 1880, it was agreed that the $400 to be paid by the Engineers' Society for the use of hall should be devoted wholly to the purchasing of periodicals of a scientific and technical character for the reading-room.

A number of journals have been added to the collection on the tables of the reading-room, but the cost of these new journals is estimated at $115.

Respectfully submitted for the committee.

FRANCIS C. PHILLIPS.

REPORT OF THE COMMITTEE ON TESTS.

To the President of the Society of Engineers of Western Pennsylvania:

SIR: The Committee on Tests, in the absence of any original work which it is able to lay before the Society, begs leave to submit the following statement of the affairs of the U. S. Commission for the testing of iron, steel and other metals.

In the year 1875, through the exertions of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Iron and Steel Association, and other scientific bodies, Congress created a commission to test iron, steel and other metals, and appropriated a sum of money for this purpose. The commission was composed of one engineer officer of the army, one officer of the Ordnance Department, two of the navy and three civil engineers, and began its labors very auspiciously. A number of tests were made in the government testing machine at the Navy Yard in Washington, chiefly on chain cables, and a report was published, a copy of which is in possession of the library of the Society. The chief fruit of the labors of the Commission, however, is represented by the admirable testing machine at the Watertown Arsenal which it had built, but the use of which it never enjoyed. Even before its completion the funds of the Commission gave out, and all efforts to obtain additional appropriations from Congress proved futile, except so much as was necessary to pay for the machine. After its completion it passed into the hands of the Ordnance Department of the Army, and by a law of Congress was made available to private individuals for purposes of tests on payment of costs. Extensive use has been made of this privilege, and the Department has also been able to make a limited number of tests on its own account. Among these are the tests on lined and unlined cast-iron cylinders subjected to internal pressure, copies of a report on which were furnished the Society through the kindness of Colonel Laidley, U. S. A., commanding Watertown Arsenal. Altogether a considerable number of tests have been made, and much information of value could no doubt be gathered from them, but very little has been published, and they as yet await the hand of some one who will work out the results systematically, and give proper interpretation to them.

Your committee is happy to state that active steps have been taken by the American Society of Civil Engineers, aided by other societies, in effecting a reappointment of a commission and securing an appropriation from Congress. At the meeting of the American Institute of Mining Engineers at Washington next month an united effort will be made to interest members of Congress in the subject and obtain favorable action during the present session of Congress. It is expected that the new commission will be placed on a better basis than its predecessor, that its powers will be greater, and that certain errors of organization which impaired the usefulness of the former commission will be avoided. There is every prospect that these efforts will meet with success, and the near future will see this, the most promising movement made in many years toward advancing our engineering knowledge, again under way and accomplishing results.

The committee regrets that one of its members, Mr. Kent, has been seriously ill for several months, and still continues so, in consequence of which his signature does not appear.

Respectfully submitted.

C. L. STROBEL,
J. W. WALKER,
Members Committee on Tests.

PITTSBURGH, Jan. 17, 1882.

THE ANNUAL BANQUET.

The second annual banquet of the Society was held at the Monongahela House on the evening of the 7th, and was fully as enjoyable as those concerned could possibly desire. When men whose brains are employed in the perfecting of huge undertakings, in the creation of enduring forms in iron and stone and wood, lay aside for the moment their graver duties, their hours of relaxation are marked by keen enjoyment, ready wit and polished speech. Such was the case in this instance. The banquet table was surrounded by members and invited guests shortly before 9 o'clock, and for three hours the elaborate *menu*, and the higher pleasures of thought and speech were alternately enjoyed. At the head of the table sat President Gottlieb, portly, gray-whiskered and urbane; at his right

Continued on Page 68

ENGINEERING NEWS.

GEO. H. FROST..............Proprietor.
Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, Editor.
S. D. V. BURR............ ....Associate Editor.

SATURDAY, FEB. 25, 1882.

EDITORIAL ANNOUNCEMENTS.

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Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

THE AMERICAN WATER-WORKS ASSOCIATION.—The second annual meeting of the American Water-Works Association will be held in the City Hall, Columbus, O., on Tuesday, March 14, 1882. J. H. DECKER, Secretary.

SENSATIONAL SCIENCE—THE IMPURITIES OF WATER.

We learn from the London *Architect* that at a meeting of the Institution of Civil Engineers, on the 24th inst., Mr. C. Falkard pointed out that "mere dilution had an almost inappreciable effect in disarming the germs of disease of their power. Now, supposing a glass of water to contain but one germ, if the person were weakly or sufficiently unhealthy, he would contract the disease almost as certainly as if there were hundreds of germs." According to Mr. Falkard, it will be impossible to banish zymotic diseases from towns, the water supply of which contains the dejecta of persons suffering from disease, *even though present in the most minute quantity.* "The very weakly contract the complaint from the water, and from them it will spread to the most robust around them, the germs being endowed with such persistent vitality that they withstand the effects of heat and cold, moisture, drought and chemical agents to an almost incredible extent, affording what seemed at first sight indisputable evidence of the now exploded docrine of spontaneous generation."

At a meeting at the Academy of Medicine in this city a short time since (N. Y. *Herald*, Feb. 2), Prof. Doremus demonstrated how the densest stone walls are easily penetrable by the gases of decomposing vegetable or animal matter, and, according to the reported proceedings, "he took a solid-looking section of the finest Philadelphia brick, 8 in. thick, and blew out a candle by the force of his breath through the apparently impenetrable thickness of the brick!" And at the same meeting Dr. Willard Parker, after acknowledging that the penetrative power of the fatal gases, as exhibited by Prof. Doremus, had been previously unknown to himself, stated that "previous to the introduction of the Croton water in 1842 no diphtheria was known in this city!" "and if he were to build a house now, he would have no connection with the sewers," and concluded by stating "that New York was in an exceedingly critical condition in this respect, and the time had arrived for energetic action."

We of course believe that a disregard of the plainest rules of hygiene will be likely to be attended with a lowering of the tone of the individual system, and if persisted in will sooner or later destroy the health and very possibly, in some cases, result in premature death. But we do not believe that the varying death rate shown by the bills of mortality in cities is attributable solely, or largely, to the varying condition of the public sewers with reference to the dissemination of sewer gas. The mode of life, better food and clothing, more of it, comparative exemption from the depressing influences attending a struggle for bare existence, all these improved conditions and others which could be cited, give a sufficient explanation for the fact that the death rate in localities has decreased in spite of the influence of certain new conditions which the comforts of modern life in cities have rendered necessary, but which the sensational scientist loses no opportunity to hold up to the public as attended with the extremest danger. Pure air, pure water, wholesome food, cleanliness, the prompt removal from dwellings of decaying organic matter, the prevention of crowding in the dwellings of the poor, the establishment of hospitals to which patients laboring under infectious diseases shall be removed for medical treatment—these are the requisites to a proper sanitary condition, and yet with all these requisites in the highest possible condition attainable, experience has shown that what sanitarians consider as a preventable disease may yet step in, no one knows how, and decimate such a locality in spite of the best medical treatment. Look at the ravages of the cholera. A surgeon of great experience in the English army in India, and subsequently in charge of the Cholera Hospital in Quebec when this plague visited the country in 1832, informed us that about the same percentage of the population were taken sick, and *precisely* the same percentage of the taken sick died, in either case. In the one, a total absence of all remedial agents whatever, and the climate and the surroundings in the highest degree conducive to the spread and severity of the disease; while the other, replete with every aid which science could afford, and a climate and surroundings such as might be selected for favorable treatment of disease, yet the result was the same. Every physician of experience has witnessed in his own practice similar instances of the potency of disease and the impotency of safeguards to its approach, and of medical treatment toward arresting its ravages; and yet there is nothing more certain than that the advent of this special disease is preventable; but its proper treatment, when at its height, is yet a matter of opinion, from the fact that, while the occasion of the disease in many cases appears obvious enough, its cause is as yet beyond our ken. In other words, the theory—or, we should say, the hypothesis—upon which the propagation of diseases of a zymotic type are based, is faulty; and when we state as a fact that, setting aside minor differences of opinion, which would increase the number materially, there are no less than *four* distinct theories of the causes of diseases of this character, all sustained by highly respectable authority, it will be apparent that preventive measures against the approach of disease are at least liable to some uncertainty of successful application; and yet we must admit it to be true that, so far as our limited vision extends, the means resorted to, or recommended, by the advocates of either of these theories of the propagation of disease, as precautionary measures, would possibly prove equally efficacious, whichever theory was correct; precisely as if, when the cholera was raging in Cadiz, we will say, if the authorities of Charleston were so thoroughly energetic as to prevent absolutely all communication between the two cities, upon the supposition that the yellow fever raged in Cadiz, their efforts might prove successful in keeping out the disease, notwithstanding they had wholly mistaken the nature of the disease.

But this would scarcely be satisfactory to the modern searcher after truth, and therefore we dwell upon the fact that Mr. Falkard talks of one germ being as potent for mischief as hundreds of germs, in the case which he supposes of the contamination of water, complacently regarding the germ theory of the propagation of disease as conclusively established as a fact in nature. Now, while the fact is too patent to be denied that poisoning by bad water is well established, it is far from proven that the occasion of the disease in human beings in drinking bad water arises from a living germ, conveyed by the water; and which germ, derivable from a putrefactive process, is almost immortal in its nature; at least no limit is set to its duration after birth, and is invulnerable during its lifetime to such assaults as extremes of heat and cold, moisture or drought, or corrosive acids, and will still retain the vitality essential to its own reproduction, and to an almost incalculable extent, so that when the surroundings are favorable, myriads of similar germs are propagated, each with the same potency for mischief when taken into the human body. If this be so, is there any cause for wonder that one germ would be as fatal as hundreds? Or rather, is it not an occasion for wonder that such an occurrence as the presence of a single germ by itself in a tumbler of water should be even thinkable? Recollect, that all this time, no one ever saw one of these germs, or a family of one hundred thousand of them, it having been estimated that five millions of them would find ample room upon a small pinhead.

Should we venture to combine the dangers to our life and health as shown by Mr. Falkard, with the assumed wonderful fecundity of the disease germ, added to the difficulty as shown by Prof. Doremus of fortifying ourselves by even stone walls against his insidious attacks, and then learn from Dr. Parker that, owing to the introduction of the Croton water, with the attendent circumstances above noted, the most fearful results might be apprehended as likely to occur at any moment—we might well pause aghast.

If the science of the age has at an enormous expense brought to our doors the Croton water, of which we are debarred the full benefit by reason of the incalculable swarms of deadly parasites with which it brings us into contact, and against which the densest stone wall will prove an insufficient barrier, we can scarcely hope for more than to wage a losing battle with these invisible antagonists, and finally, in common with the whole human family, succumb to their assaults. But, thank Heaven, there is a balm in Gilead and a physician there equal to the occasion. Nature herself, who builds up and tears down through inexorable law, has established a just balance between opposing forces, and has decreed the precise bounds beyond which none of her products can go. As an illustration: It is estimated that a single female of the cod species would, in twenty years, if not preyed upon by other than man, succeed in stocking the Atlantic Ocean beyond its capacity for other uses! So it has been decreed that the waste of organic life shall, after undergoing a natural transformation, support lives, which in their turn shall again be transformed to useful purposes; and to this end the vital principle, or oxygen, in earth, air or water, becomes the chief agent.

Some twelve years since, a commission of scientific men was appointed to inquire into the potobility of the Thames River waters, London. After taking the evidence of eminent scientists, engineers and others to an exhaustive extent, the report embracing the evidence was published in a folio of 760 pages exclusive of maps and plans. Dr. Chandler, late president of the New York Board of Health, and Professor of Chemistry in School of Mines, in a paper published by him in 1873 on the "Sanitary Chemistry of Water" quotes freely from this report in support of his own views. In refutation of Mr. Falkard and Dr. Parker's "Sensational Science" of a single germ in drinking water being sufficient to establish an epidemic of typhoid fever, we quote two extracts from Dr. Chandler's paper, one from the testimony of Dr. Angus Smith, a distinguished chemist, and the other from the report of the commission:

Dr. Angus Smith: "We do not know that the germs ever can be carried in pure water; the dissolved oxygen may destroy them, as it unquestionably does putrescent matters. A positive proof of their transmissions in otherwise pure water is wanting. * * * It seems probable that disease cannot be carried far by pure air, nor by water with much oxygen in it, which is equal to pure air. We are informed that the atmosphere is full of germs, but the evidence seems to be, that it requires an unusual excess to attack us successfully; it seems to be a question of quantity."

Report of Commission: "The organic contamination of the Thames is much less than is commonly imagined, still it would be sufficient to do great mischief, were it not for a most beneficial provision of nature for effecting spontaneously the purification of the stream. Some of the noxious matter is removed by fish and other animal life, and a further quantity is absorbed by the growth of aquatic vegetation; but, in addition to these abstractions, important changes are effected by chemical action. The organic compounds, dissolved in water, appear to be of very unstable constitution, and to be very easily decomposed, the great agent in this decomposition being oxygen, and the process being considerably hastened by the action of the water. Now, as such waters always contain much air, dissolved in them, the decomposing agent is ready at hand to exert its influence the moment the matter is received into the water. * * * The effect of the action of oxygen in these organic matters, when complete, is to break them up, to destroy all their peculiar organic constitution, and to re-arrange their elements into permanent inorganic fumes, innocuous and free from any deleterious quality. This purifying process is not a mere theoretical speculation. We have abundant practical evidence of its real action in the Thames and other rivers."

We think the single germ in a glass of water, as well as the poisons to be apprehended from the copious Croton supply, need not excite our fears as anything more alarming than "sensational science."

THE MALARIA SUIT AT PITTSFIELD.

A large contest, involving a number of important points, was unavoidably, not to say unfortunately, postponed at Pittsfield, Mass., last month. Among other matters that will probably be determined when the case comes to trial will be the status and rights of mill-owners as against a probable injury to the public health by the manner in which their business may be conducted. On the other hand, the rights of communities to protection from diseases that may be prevented will have to be determined.

The case in point is simply this: The Smith Paper Company, acting under the laws of the State of Massachusetts, have constructed a dam in the Housatonic River, which although but eight ft. high set the water back in the stream for about seven miles, there being only a fall of eight ft. in this entire distance. As a matter of course such an obstruction in a stream of so little fall necessarily produces a large amount of soil saturation. The valley of the river at this point is from one-half to three-quarters of a mile in width, and an enormous marsh has resulted from the soil saturation. On both sides of the river the residents with scarcely an exception have suffered from some form of malarial disease, which is ascribed solely to the marsh. The inhabitants of Lenox, through the Town Committee, have brought an action against the Smith Company. That is to say, at their instance an indictment for maintaining a nuisance has been procured, and the trial on this indictment was the one that was postponed.

From an engineering standpoint the question turns on the proper method of impounding water for industrial purposes. It is well established that water for domestic use should only be impounded in a reservoir, from which all vegetable matter has been first removed. This is the only way to secure pure water, and the only way to prevent the reservoir from being a source of insalubrity to the neighborhood in which it is located. Undoubtedly for the same reason all reservoirs should be so constructed. It is true that this involves a certain amount of expense, not at all times possible to small capitalists and always onerous to large ones. Nevertheless in the rapid augmentation of population, sanitary questions of a serious character are coming to the front that require earnest consideration, and the rights of all must be respected in the conduct of any industry, no matter what the vested rights of that industry may be. We shall look with deep interest to the progress of this suit, as it is understood that a great deal of expert testimony of an important character is to be introduced.

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UNIFORM CONVENTIONAL TINTS.

In reference to the subject of conventional tints for mechanical drawings: many years ago, before the day of uniformity in anything, we adopted for our own use, as the most suitable color, the local color in the shade of the material to be represented, and have so continued for over a quarter of a century. We now find by a circular of James W. Queen & Co., 924 Chestnut street, Philadelphia, that these very colors are sold in cake by them as "Standard Technical Water Colors." The colors named as copper, brass, steel, wrought iron, cast iron, brick, stone, wood, leather, are the very tints which we had selected and used as the nearest possible when applied in a thin wash, to the local color of the object, and hence better suited to the purpose than would be colors which were purely conventional.

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SCIENCE.

A journal devoted to news, even though it be engineering news, is not thereby necessarily a scientific journal, but, notwithstanding, may with propriety be looked to occasionally for news of a scientific character, and hence, while acknowledging the paucity of our claims to being regarded as scientists, we can occasionally select what will be regarded by many of our readers as scientific news, and therefore make no further apology for inserting the following from the January number of the "Scientific Proceedings of the Ohio Mechanics' Institute:"

Professor Eddy read a paper upon "The Earth—Its Form and Shape." He explained how the earth's form resembles an orange, and the true form to which it approximates is defined as that which the earth would have were its surface all water. He explained how the true level varies in places, due to local attraction of large masses of matter, either upon the surface, or of greater density beneath. As an example, if a canal could be excavated through a mountain range, so that the sea water could enter it, the water level would be higher at the center of the range than at the sea, due to the "attraction of the mass of earth forming the mountains."

Having had occasion some weeks since to call attention to a late work of Professor M. Merriman, on the figure of the earth, and the geodetic operations from which it had been deduced, we stated, on his authority, that the figure of the earth resembled that of a potato. If we have unguardedly misled any of our readers upon this important point, we hasten to correct it, and assure them that we do not of ourselves pretend to know whether it most resembles an orange or a potato, but sure we are that it cannot resemble both orange and potato.

Assuming that the true form to which the figure of the earth approximates, is what it would have, were its surface all water, Professor Eddy explains the variations from this form which exist, "as due to local attraction of large masses of matter, either upon the surface, or of greater density beneath." As we understand the Professor, he does not refer in this to variations in the level of the land, but that variations in the absolute levels of the sea, marking its approximation to the surface form of an orange, are due to these attractions, and illustrates it by an example of a cut through a mountain range, say from ocean to ocean, wherein he says, "that the level of the water would be higher at the center of the range than at the sea, due to the attraction of the mass of earth forming the mountain." If this be so, as we doubt not that it is in mathematical symbols, then as a consequence, all waters which wash the shores of high mountain ranges, undergo this variation from the general law of hydrostatic level due the attractive force of the gravity of the *whole earth*; and mathematically, the shores of all continents and islands, instead of presenting a uniformity of sea level, as we had carelessly supposed they did, they really vary in absolute level, depending upon the attractive force of masses of matter in their vicinity.

The consideration of this important factor in the determination of the approximate figure of the earth has opened up grave doubts in our mind whether, indeed, the globe on which we dwell most resembles a potato or an orange. Superficial thinkers might regard this question as of little importance either way, and consider it about on a par with the computation of the bending moment, and consequent divergence of aim, occasioned by a fly lighting on the muzzle of a rifle. But in science nothing can be regarded as too little for its research.

Some of our readers must have seen an article published in the *Atlantic Monthly* in 1875, entitled "Old Times on the Mississippi," by Mark Twain, which, although not precisely engineering *news*, is most decidedly a *new* view to take of the possible errors which may grow out of a too strict adherence to figures merely; an extract from it will bear republishing for the benefit of some of of our scientists.

"The Mississippi between Cairo and New Orleans was 1,215 miles long 176 years ago. It was 1,180 after the cut-off of 1722. It was 1,040 after the American Bend cut-off, some seventeen years ago. It has lost 67 miles since. Consequently its length is only 973 miles at present.

"Now, if I wanted to be one of those ponderous scientific people, and 'let on' to prove what had occurred in the remote past by what had occurred in a given time in the recent past, or what will occur in the far future by what has occurred in late years, what an opportunity is here. Geology never had such a chance, nor such exact data to argue from. Nor 'development of species' either. Glacial epochs are great things, but they are vague—vague. Please observe:

"In the space of 176 years the lower Mississippi has shortened itself 242 miles, that is an average of a trifle over $1\frac{1}{3}$ miles per year. Therefore, any calm person, who is not blind or idiotic, can see that in the old oolitic silurian period, just a million years ago next November, the lower Mississippi River was upward of 1,300,000 miles long, and stuck out over the Gulf of Mexico like a fishing rod, and by the same token any person can see that 742 years from now, the lower Mississippi will be only $1\frac{3}{4}$ miles long, and Cairo and New Orleans will have joined their streets together, and be proceeding comfortably along under a single mayor and a mutual board of aldermen. There is something fascinating about science, one gets such wholesale returns of conjectures out of such trifling investment of fact."

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BROOKLYN CITY WORKS.

REPORT OF CHIEF-ENGINEER ROBERT VAN BUREN TO THE COMMISSIONER OF CITY WORKS.

As a matter of the first importance, attention is called to the water supply.

The average daily consumption for the year 1881 was 32,731,500 gallons. The maximum consumption was 44,720,440 gallons. The minimum supply from streams and ponds he estimates at 25,000,000 gallons, and from the new wells already built near Springfield and Water Pond 6,000,000 gallons more; and if a similar well be sunk between Jamaica and East New York, with side galleries, which will yield 5,000,000 gallons, of which there can be no doubt, the daily minimum supply may safely be estimated at 36,000,000 gallons, not including in this estimate anything obtained by storage in the Hempstead Reservoir. While this reservoir has accomplished all that was promised by it; that it to say, when the *minimum* flow of the stream was estimated as 20,000,000 gallons daily, it was assumed that a storage could be made from the winter and spring rains in this basin, which, held in reserve for supplementing the low summer flow, would for 100 days insure the 20,000,000 gallons daily being increased to 30,000,000. The reservoir has shown its capacity to accomplish this, but the exigencies of the water service have prevented this reservoir being regarded as a reserve merely for a limited time in the season of drought, and it has of necessity been included in the current operation of the works at all times and seasons precisely as any of the other ponds.

The use of the new wells from which the water is pumped into the conduit has proved so successful, even beyond the anticipations of the engineer, that it would seem feasible by their judicious use to bring up the supply to the capacity of the conduit, and at a less cost than by an extension of the work eastward or than by a general introduction of meters to endeavor to limit consumption in the city to the present amount of their water supply. The engineer recommends an appropriation of $250,000 to this end and shows its benefits over the meter system.

The length of sewers built during the year was $2\frac{1}{2}$ miles, and the engineer recommends the extension of the Third avenue sewer from Twenty-eighth to Fortieth street, at an estimated cost of $150,000, and the provision of storm water overflow to the lately completed Bond street sewer, and also recommends the use of the perforated covers for man-holes for the 300 miles of city sewers, which method of ventilation is now recognized as likely to take the place of any other.

He also repeats his recommendations of previous years, that a fourth engine and conveniences for its use be added to the present (three) engine power at Ridgewood at an estimated expense under $200,000, and also that the distributing reservoir at Ridgewood be enlarged proportionally to the increase in consumption of water, from a capacity of 160,000,000, as at present, to double that amount, or 320,000,000 gallons.

The extent of building last year was 2,000 houses, and the engineer broadly intimates that the indications of the prosperity of the city can in no better way be assured than by a liberal extension of such improvements as modern civilization calls for in great cities.

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PERSONAL.

R. H. **TALCOTT** is chief engineer of the Richmond & Mecklenburg Railroad.

H. A. **SCHWANECKE** has been appointed chief engineer in charge of construction on the Pittsburgh & Western Railroad.

S. B. McKee, late Locating Engineer on the Ontonagon & Brule River Railroad, Michigan, has been appointed Locating and Resident Engineer Credit Valley Railway, with headquarters at Toronto, Ont.

MAJOR S. HERSCHEL, of the royal engineers, son of the illustrious Sir John Herschel and grandson of the famous astronomer, Sir William Herschel, is now in Washington. He visits this country at the request of the superintendent of the United States Coast and Geodetic Survey—Prof. J. E. Hilgard—for the purpose of taking part in certain delicate pendulum observations for determining the exact force of gravity at this point; bringing with him for that object the pendulums which have been already used in the same service both in England and in India. Prof. S. F. Baird has offered the necessary facilities for these experiments, which will be conducted by Major Herschel, and Prof. C. S. Pierce, of the Coast Survey, in an apartment in the Smithsonian building set apart for the purpose. It may be well to state that the ultimate object of these very delicate determinations to be made at numerous points around our globe is to ascertain more precisely its figure, that is to say, its amount of deformation from a true spheroid of revolution, when reduced to a uniform sea-level.

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THE IRON TRADE.

(Prepared Expressly for ENGINEERING NEWS.)

An unlooked-for contraction of operations of the Gould syndicate in regard to western roads diverging from St. Louis has had a dampening effect on the steel-rail market. Whether its curtailment of operations is to be of long duration cannot be known. The strange policy is a surprise to railroad builders, to investors and to the Western public, which knows of no reason why railroad construction should not be prosecuted vigorously. Perhaps there are too many roads projected—too much mileage—the completion of which might compel an internal competition. Extensions and improvements have been stopped; some rail contracts have been cancelled; some lots of rails have been offered for sale. Mr. Gould's interference is not favorably regarded by many, but perhaps he is proving himself a public benefactor in checking undue activity in railway building, which so many are anticipating. It is not likely the Gould syndicate will build too few roads. It is possible that the individual concerns in the great Southwest, struggling for the control of prospective traffic, should build too much road. The Gould Huntingdon combination in the far Southwest has nipped projected construction in the bud. These movements are mere factors in the railway problem. The country nor the steel manufacturing interests cannot profit by any overdoing in railroad construction. The weekly announcements of new roads guarantee sufficient activity. The policy of no one combination of roads can seriously interfere with railroad construction. The country is too large for that. The very active demand for steel rails has pushed their price beyond fair limits. Foreign competition and the expanded facilities for production at home have recently brought about a needed revision of quotations. Large lots of Bessemer steel rails can be bought at $54 to $55. The decline has not attracted buyers, as might be expected, because of two or three facts. A further decline is thought probable. Deliveries cannot be promised, except at remote dates. Buyers, therefore, would prefer to wait and meanwhile profit by any favorable happenings. Nothing unfavorable can happen.

Foreign steel production is increasing rapidly. As long as continental and colonial demand keeps up the way is clear. Should it decline unexpectedly or gradually, American markets would very soon feels the effects in increasing competition and depressed prices.

The American merchant and construction iron mills are abundantly provided with orders, and prices are in the main stationary. Consumers betray considerable caution or prudence in anticipating requirements. They know that capacity on both sides of the water is increasing, and that in the long run a decline in prices is inevitable.

Blast furnace capacity is gradually increasing. Imports have not taken place. Ocean freights render exportation of crude or finished iron practically impossible. Large surplus stocks abroad continue to threaten our markets, but the probabilities of shipments on a large scale at an early day are remote. The steel works are crowded with orders at remunerative and improving prices.

Demand is increasing, particularly in the West, where steel for agricultural, mining and manufacturing purposes is growing in demand.

ENGINEERS' SOCIETIES.

THE AMERICAN INSTITUTE OF MINING ENGINEERS.

The annual meeting of the Institute was called to order at 8 p. m. on Tuesday, in the lecture-room of the National Museum Building, Washington, by President Metcalf. An address of welcome was read by General Sherman, which was supplemented by some remarks from Major J. W. Powell, Chairman of the Local Committee, after which President Metcalf read the announcements for the meeting. The members and ladies accompanying them afterward attended a reception given by Major and Mrs. Powell at their residence, where they had the pleasure of forming mutually agreeable acquaintanceships, and also an opportunity of meeting General Sherman, Vice-President David Davis, Senator Hoar, Spencer F. Baird and other gentlemen distinguished in the political and scientific circles of society.

Wednesday forenoon was devoted to the reading of papers and in the afternoon a special session was held in memory of the late ALEXANDER LYMAN HOLLEY, which was honored with a full attendance of members and visitors, and at which many eloquent addresses and numerous letters and cablegrams were read from the intimate associates of the distinguished engineer whose loss is severely felt by all who knew him.

The evening session was devoted to the special subject of discussing the testing of iron and steel and other structural materials preliminary to memorializing Congress on the creation of a Commitee on Tests of these materials. Papers were read and remarks made by Messrs. A. Welch, Chas. Macdonald, Gen. Meigs, Capt. Lyle of the Springfield, Mass., Armory, E. D. Leavitt, T. C. Clark, O. Chanute, A. P. Boller, T. Egleston and W. H. Paine. The subject was continued and other papers read on Thursday a. m., and in the afternoon of the same day the members and ladies accompanying were received by the President and afterward were accorded the special favor of being shown through the several parlors of the White House; they were next escorted through portions of the Treasury Building and were received by Secretary Folger in his office. In the evening over 100 sat down to the subscription dinner at Wormley's, which, like all social gatherings of engineers, was a pronounced success. Friday was given up to reading papers in the morning, and an excursion, as per programme, in the afternoon. The following papers were read at the several meetings:

A process for making artificial fuel from anthracite and bituminous coal dust, and the applicability of the process to the utilization and solidification of the slacking lignites of the West, by E. F. Loiseau, Philadelphia.

Southern fire clays, by Prof. P. H. Mell, Jr., Auburn, Ala.

Balance of Petroleum remaining in Pennsylvania and New York, by Henry E. Wrigley, Philadelphia.

Notes on the Luermann Front, by George Asmus, New York City.

A new Ore Pulverizer, by C. Henry Roney, Philadelphia.

The Crystalline Rocks of Virginia compared with those of New England, by Prof. C. H. Hitchcock, Hanover, N. H.

Contributions to the Metallurgy of Nickel and Copper, by Henry M. Howe, New York.

Comparative Efficiency of Fans and Positive Blowers, by Henry M. Howe.

Some Drift Deposits of Fossiliferous Hematites in Tennessee, by Edward Nichols, Ridge Valley, Ga.

Phosphorus Determinations in Pig Iron and Steel, by F. E. Bachman, South St. Louis, Mo.

Instruments for Projection Drawing, by Prof. J. M. Silliman, Easton, Pa.

The Gold-bearing Sands and Quartz Veins of the Jaina River, San Domingo, by R. P. Rothwell, New York City.

Note on the Result of the Blast in the Glendon Limestone Quarry, by Frank Firmstone, Easton, Pa.

Electrical Apparatus and Processes for the Mining and Metallurgical Engineer, by N. S. Keith, New York City.

Hoefer's Method of Studying Faults in Veins, by R. W. Raymond, New York City.

The Gold-bearing Conglomerates of the Black Hills, Dakota, by Walter B. Devereux, Globe, Arizona.

The Valuation of Iron Mines in New York and New Jersey, by Prof. J. C. Smock, New Brunswick, N. J.

Late Developments in the Siemens Direct Process, by George W. Maynard, New York City.

Chimney Draughts, by Prof. B. W. Frazier, Bethlehem, Pa.

Notes on some newly dicovered Mineral Regions of Southern New Mexico, by Prof. B. Silliman, New Haven, Conn.

Supplement III to a Catalogue of Official Reports upon Geological Surveys of the United States and Territories and of British North America, by Fred. Prime, Jr., Philadelphia.

First Aid to the Injured, by Prof. H. S. Munroe, New York City.

A Review of the Ste. Genevieve Copper Deposit, by Frank Nicholson, Ste. Genevieve, Mo.

Notes on the New Mill at Batopilas, Mexico, by J. C. F. Randolph, New York City.

On the Necessity of Government Aid in Organizing a System of Tests of Materials used for Structural Purposes, by Charles Macdonald, New York City.

Note on the Watertown Testing Machine, by E. D. Leavitt, Jr., Cambridgeport, Mass.

On the Effort to Organize a New Board for the Testing of Iron and Steel, by Alfred P. Boller, New York City.

The officers elected were as follows:

President, R. P. Rothwell.

Vice-Presidents, T. N. Ely, Altoona; C. Macdonald, New York; Major J. W. Powell, Washington.

Managers, Wm. Burnham, Anton Eilers, A. S McCreath.

Treasurer, T. D. Rand.

Secretary, T. M. Drown.

ENGINEERS' CLUB OF PHILADELPHIA.

Record of regular meeting held Feb. 4, 1882, at the rooms of the Club:

President Rudolph Hering in the chair.

Mr. Wm. A. Cooper presented a description of the progress in methods and contrivances for uniting the ends of rails, a subject of much thought among engineers, as the hundreds of patent fish-plates, chairs, nut-locks, etc., show. From wooden rails, spiked to sleepers embedded in the ground, an advance was made, about 1765, to iron straps nailed upon the wood to diminish wear. In 1767, at the Colebrookdale, Eng., Iron-Works, cast-iron rails, 4 in. wide by 1¾ in. thick by 5 ft. long, were laid. In 1789 cast-iron rails are said to have been set and bolted in cast-iron chairs fastened to sleepers, and in England the general method of wedging or bolting the rails to chairs fastened to the ties has continued to be the general practice.

In early American railroading, the strap rail of "snake-head" celebrity was used for economical reasons, but soon abandoned for the T rail. In 1847 the fish-plate or splice-bar, which has superseded, in this country, all other means of fastening, was designed. It consisted of a pair of plates 18 in. by 3 in. by ¾-in, bolted over joint by 4 bolts, 2 to each rail, with oval bolt holes to admit of expansion and contraction in the rail. A later improvement was the use of angle plates, giving greater support to rail and larger bearing surface, and admitting the spike slot in the plate, instead of the rail, to prevent creeping.

The remainder of the paper was devoted to the discussion of various forms of nuts and washers designed to obviate the loosening of the nuts and elongation of the bolts. A large number of specimens were exhibited.

Prof. L. M. Haupt read a paper upon "How to Establish a True Meridian," the object being to present the subject in a manner sufficiently clear and practical to be generally understood by those desiring to make use of such information. Explicit definitions and explanations, with applications to practical methods, are given in this paper, accompanied by azimuth, refraction and equation of time tables.

The Secretary presented, on behalf of Mr. Howard Constable, a description of a pneumatic pulverizer, which consists, in brief, of a chamber into which are introduced two injector nozzles, opposite each other, and each connected with a funnel for the reception of the material to be pulverized. By the expulsion of superheated steam through the injectors, the material, previously crushed to about the size of a pea, is forced into collision in the chamber, and about 95 per cent. thereof is thereby reduced to fine dust and carried by the exhaust into a settling chamber, the tailings being collected in the bottom of the chamber and returned to the funnels. By a 20-horse boiler, 120 lbs. pressure, 1½ tons per hour have been pulverized, and it is expected to increase this to 2 tons per hour by a pressure of 200 lbs., and take the place of a 20-stamp mill which weighs about 4,000 lbs., while this machine proper weighs about 100 lbs. only. Specimens of quartz, in crushed fragments and powder, were submitted—the latter being almost entirely composed of an impalpable dust. It is designed to make use of this machine for pulverization in general.

HOWARD MURPHY,
Secretary and Treasurer.

LIVERPOOL ENGINEERING SOCIETY.

The second meeting of the session was held at the Royal Institution on Wednesday, the 1st inst., at 8 o'clock, the president, Mr. F. Salmon, M. I. and S. Inst., in the chair.

After the usual business, Mr. William Goldstraw read a paper on "Municipal Control of Streets and Buildings."

The author showed that from the earliest times the arm of power had been put forth in the control of streets and buildings, generally with much benefit to the community. Ancient Rome and medieval Europe were referred to for instances of restrictions in these matters. In Paris there had been building regulations of gradually increasing severity from the 13th century to the present day; and that city had now reached a higher standard in this respect than perhaps any other place. In England public control of buildings dated as far back as 1189, when twelve aldermen of London formed a court to assist the first Mayor in dealing with this special subject. After referring to the determined efforts made in the reigns of Elizabeth and James to impose limits on builders, the author dwelt on the rules for rebuilding London after the great fire of 1666. The act then passed was in many points the prototype of all building acts; in some respects it went further than modern regulations.

Since that period a large number of statutes had been passed to insure the health, safety and comfort of dwellers in towns. The author traced the history of these enactments and of many attempts to consolidate and amend them, and showed that both in London and the provinces the number and intricacies of the various laws and authorities on the subject were causes of great annoyance and perplexity both to officials, and persons to concerned in building. Municipal surveyors found great lack of information on the subject; and nearly every town had rules differing from those of another. The remedy he suggested was a general Building Act for the whole country. As a beneficial example the Public Health Act, 1875, was referred to. The author believed that the Model By-laws issued by the Local Government Board in 1877 would pave the way for a general statute; and that body appeared to be the only one able to frame and carry such a scheme. Architects and engineers could help on the desired end by procuring local enactments having features in common, and by speaking in concert on behalf of a comprehensive measure. The passing into law of the lapsed County Boards Bill, or of the expected County Government Bill, might create an immediate necessity for a general building act. Isolated effort could do little in such a matter. To the unsuccessful bill promoted by the Metropolitan Board of Works in 1874 must now be added a partial failure in our own locality. The City Engineer had recently put forward a complete proposal for the consolidation and amendment of the building regulations of Liverpool which might have formed a rough basis for a general act. This scheme, however, had been consigned to the limbo of unrealized projects.

In conclusion the author urged that as public opinion on these topics was ill-informed and indifferent it was the duty of those who knew the facts to attempt some improvement; and he called upon municipal engineers desirous of promoting the public interests, and a general increase of health, sweetness and light, to give this subject their earnest attention.

A discussion followed the reading of the paper, and a vote of thanks was given to the author.

The President announced that the next meeting of the society would take place on the 15th, when the discussion on Mr. Goldstraw's paper would be resumed, and owing to the importance of the subject a large attendance is anticipated.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 59.

CCXI.—LENOX.

Lenox, Massachusetts, in lat. 42° 20′ N., long. 73° 12′ W., is on a hill 1,200 ft. above tide level, in the center of the Housatonic Valley, and surrounded by mountains.

Settled about 1760, it was incorporated as a town in 1767. In 1875, water-works were built by a private company, after plans of George Murdock, taking the supply from mountain springs, draining a water-shed of 1¼ square miles. Three dams of stone, laid in cement, impound the water in reservoirs holding respectively 40,000, 500,000 and 165,000 gallons. The last named is the distributing reservoir, and is 100 ft. above the village. The water is filtered through stone and gravel, with fairly good results.

An additional supply in case of droughts is obtained by pumping into the reservoir from the river, 190 ft. below it.

Distribution is by cast-iron pipe of 4 and 3-in. diameter, of which 5¼ miles are laid, with 5 fire hydrants, 8 gates and 115 taps. The town does not pay for use of hydrants. Service pipes are of wrought iron.

The population in 1880 was 1,400 and the daily consumption is estimated at 50,000 gallons.

The capital stock of the company is $22,000. The works have cost $25,000. Further financial statistics are not furnished. William D. Curtis is the Treasurer and Manager.

CCXII.—MONTICELLO.

Monticello, Iowa, in lat. 42° 15′ N., long. 91° 10′ W., is on the Maquoketa River. The town is on an elevated terrace, or what is called the "second bottom" of the river. Settled in 1858 it was incorporated in 1867.

Water-works were built by the town in 1879, after the plans of Thomas N. Boutelle, C. E.

The supply is taken from an artesian well of 5-in. bore and 1,200 ft. deep, sunk 40 ft. into the Potsdam sandstone and furnishing water of great purity.

A 6-in. Blake steam pump lifts the water 125 ft. into a circular reservoir or tank of stone masonry, holding 25,000 gallons, at 100 ft above the town.

Distribution is by 2 miles of 8-in. to 4-in. cast-iron pipe, with 20 fire hydrants, 7 gates and 80 taps. Galvanized-iron service pipes are used.

The population in 1880 was 1,800 and the daily consumption is estimated at 25,000 gallons.

The works cost $16,000. There is a bonded debt of $12,000 at 7 per cent. The cost of maintenance in 1880 was $800 and the receipts $900.

S. Y. Bradstreet, the Superintendent, is appointed by the City Council.

CCXIII.—EAST SAUGUS.

East Saugus, Massachusetts, in lat. 42° 25′ N., long. 71° 28′ W., is on the Saugus River, near the city of Lynn. Settled in 1629, it was incorporated as a town in 1815. A water supply was introduced in 1877 from the Lynn Water-works, the town of Saugus furnishing the pipes.

The distribution is by 1¼ miles of 8×6 in. wrought-iron and cement pipe, with 12 fire hydrants, 12 gates and 60 taps. The town pays $10 per hour for the time the fire hydrants are used.

Cement-lined wrought-iron services are used.

The population supplied is about 700.

The works cost $5,500. The city of Lynn keeps them in repair, and receives the water rents.

CCXIV.—HANNIBAL.

Hannibal, Missouri, in lat. 38° 44′ N., long. 91° 23′ W., is on the west bank of the Mississippi River. It was incorporated as a city in 1845.

Water-works were built in 1879–80 by a private company, after the plans of Charles A. Smith, C. E., and under the superintendence of Thomas N. Boutelle, C. E. Water is taken from the Mississippi River, ¾-mile above the city. A 16-in. cast-iron pipe extending to the mid channel, 165 ft. from the shore and 6 ft. below the surface, conducts the water to a screen well at the edge of the bank where it passes through copper ¼-in. screens to a filter well where it is passed through 3 ft. of sponge and 2 ft. of sand, gravel and charcoal to a settling well holding 250,000 gallons. The filter will pass 300,000 gallons per day effectually, and is provided with a by-pass in case more water is needed. From the settling well, the water is pumped by a Blake duplex and non-condensing engine with steam cylinders of 24 in. and water cylinders of 14-in. diameter and 24-in. stroke, into a reservoir built in excavation and embankment, puddled and lined with limestone pavement, holding 150,000,000 gallons at 210 ft. above the city. The pumps can also deliver directly into the distribution pipe, of which 10.92 miles are laid of cast iron of 14-in. to 4-in. diameter, and 1.07 miles of wrought iron of 3 and 2-in. diameter.

There are 79 fire hydrants, 72 gates, 600 taps and 5 meters in use. The city pays $66⅔ per year for each of 75 hydrants and $60 each for all over that number, and also $60 each for 8 public fountains. The company furnishes water without charge to a fountain in the public square. The population in 1880 was 14,613, and the daily consumption 2.7,640 gallons.

The capital stock of the company is $100,000.

The works have cost $102,713.95. There is a bonded debt of $90,000 at 7 per cent. Further financial statistics are not given.

J. H. Decker is the Engineer and General Manager.

CCXV.—NANTUCKET.

Nantucket, Massachusetts, in lat. 41° 17′ N., long. 70° 5′ W., is on a low island in Nantucket Bay. The town is mostly of frame houses and is closely built along the shore of the harbor. It was settled more than 200 years ago. Water-works were built in 1878 by a private company, after the plans of Moses Jay, Jr.

The supply is taken from Wannacomet pond, a natural lake of 8 acres area and 25 acres water-shed. It is 2 miles west of the town, between low hills. It is 18 ft deep in the middle and its surface is 6 ft. above sea level. The water, which is largely supplied from springs in the pond, is very pure. A duplex Blake pump, with 8-in. steam and 6-in. water cylinders of 10-in. stroke, erected in 1878, and a duplex Worthington pump, with 18¼-in. steam and 14¼-in. water cylinders of 10-in. stroke, erected in 1880, pump the water into an iron tank 25 ft. in diameter and 16 ft. deep, placed on 9 iron columns on a hill at the side of the pond, the top of the tank being 100 ft. above sea level. The only pipe is led into the bottom of the tank. In case of fire the tank connection is shut off and the engines pump directly into the distribution. The ordinary pressure varies from 18 to 38 lbs. in different parts of the town. The fire pressure is 90 lbs. The main pipe from the pond to the town is cast iron, of 8-in. diameter. In the town there are 2.6 miles of 6-in., 4-in. and 2-in. pipe, with 200 taps. Service pipes are of lead. The town has not yet taken water for fire purposes. The population is 3,000, and the daily consumption in 1880 was 28,000 gallons.

The capital stock of the company is $30,000. Further financial statistics are not furnished. William F. Codd is the Secretary and Superintendent.

CCXVI.—MILLVILLE.

Millville, New Jersey, in lat. 39° 24′ N., long. 75° 2′ W., is on the Maurice River, a small stream emptying into Delaware Bay. The town is on level ground. Settled in 1800, it was incorporated as a village in 1866. Water-works were built in 1878 by a private company, after plans of Emile Geyelin, C. E., taking the supply partly from a well and partly from a pond of 1,100 acres area formed by a dam across the river, one-half mile long, 20 ft. high, 20 ft. wide at top and 60 ft. at bottom. Pumps of 10-in. bore, driven by water-power, lift the water 128 ft. into a stand-pipe of ⅜ in plate-iron, 12 ft. in diameter and 130 ft. high.

Distribution is by 10 miles of cast-iron pipe of 12-in. to 4-in. diameter, with 66 fire hydrants and 236 taps. Three meters are in use. The town pays $2,400 per year for use of hydrants. Service pipes are of lead.

The population in 1880 was 7,660. The consumption is not stated.

The capital stock of the company is $68,000. No further financial statistics are given. Joseph McChesney is Secretary of the company.

CCXVII.—VALLEJO.

Vallejo, California, in lat. 38° 10′ N., long. 122° 13′ W., is on the Straits of Carquinas in San Pueblo Bay, 28 miles north of San Francisco. The city is in a rolling country. It was settled in 1852. Water-works were built in 1871 by a private company after the plans of Hermann Schuessler, C. E., taking the supply from a lake of 10 square miles water-shed, 3 miles northeast of the city, and having 160 acres area, created by a dam of earth 300 ft. long and 40 ft. high. A 12 in. cast-iron pipe conveys the water to the city. About half the city is supplied by gravity. For the rest the water is pumped by two Hooker pumps, 100 ft. into a reservoir of 500,000 gallons capacity on Capitol Hill, 150 ft. above tide level.

For distribution wrought-iron pipe was first used. It lasted from 6 to 8 years and has been mostly replaced by cast iron. There are now in use 18 miles of pipe of from 12-in. to 1½-in. diameter, with 35 fire hydrants, 25 gates and 1,100 taps. 12 meters are in use. The town does not pay for use of hydrants. Service pipe are principally of ¾-in. galvanized iron.

The population in 1880 was 5,000 and the daily consumption 60,000 gallons.

The capital stock of the company is $1,000,000. The works have cost $250,000. There is no debt. The expenses in 1880 were $10,000 and the receipts $24,000.

A. J. McPike is the Superintendent.

CCXVIII.—WINGHAM, CAN.

Wingham, Canada, in lat. 44° N., long. 82° W., is on the Maitland River. It was incorporated as a village in 1873, with 700 inhabitants, and as a town in 1878. Water-works were built in 1880 by the town after the plans of Thomas H. Tracey, C. E. The supply is taken from the river and is pumped directly into the mains by two double-acting piston pumps of 10-in. bore and 22-in. stroke, driven by a 36-in. turbine wheel under 12-ft. head.

One mile of 6-in. cast-iron pipe is laid with 6 double nozzle hydrants. The water is used only for fire purposes. The population in 1880 was 3,000. The works cost $8,000, which is the amount of the bonded debt bearing interest at 6 per cent. The cost of maintenance in 1880 was $240.

W. W. Inglis is Chairman of the Fire and Water Committee of the Council, which controls the works.

CCXIX.—EBENSBURG.

Ebensburg, Pennsylvania, in lat. 40° 30′ N., long. 78° 42′ W., is 2,000 ft. above sea level, in the Allegheny Mountains.

Settled in 1795, it was incorporated as a borough in 1806. Water-works were built by the borough in 1874, after the plans of James Williams, taking the supply from a 5¾-in. bored well, 1,000 ft. deep. A 8-in. brass pump, operated by a wind-mill, supplemented by steam power, lifts the water 30 ft. into a stone reservoir 30 ft. in diameter and 10 ft. deep, placed 75 ft. above the town.

The well will yield about 12,000 gallons in 10 hours. Distribution is by 1½ miles of 6 and 4-in. cast-iron pipe, with 16 fire hydrants, 5 gates and 40 taps.

Services are of ¾-in. wrought-iron pipe.

The population in 1880 was 1,160. The consumption is not stated. The works have cost $16,000. There is a bonded debt of $8,300, bearing interest at 4 per cent. The receipts in 1881 were $1,100.

Hosea J. Evans is the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks: From W. W. Inglis, Chairman Fire and Water Committee, statistics of the water-works of Wingham, Ontario, Canada. From Edw. Pierson, Secretary and Treasurer, statistics and water rates of the water-works of Morristown, N. J. From John Lockwood, Esq., statistics and water rates of the water-works of New Brighton, Staten Island, N. Y.

From Edwin Darling, Superintendent, the second annual report Water Commissioners and Superintendent Water Work of Pawtucket, R. I.

FRACTURE OF RAILS.

From observations made on Russian railways it appears that the frequency of fractures of steel rails rises as the temperature falls, the percentage of breakages having been found highest in March (18 per cent.), and lowest in June and August (3 per cent.) The same condition has been observed to prevail on German railways in the case of ties. From figures published we learn that from Oct. 1, 1879, to March 31, 1880, 480 fractures of tires, or 18.9 per cent., occurred while the temperature was above zero; 105 fractures, or 4.1 per cent., at zero, and 1,952 fractures, or 77 per cent., at temperatures below zero. The greatest number of fractures happened on Dec. 9, 10, 17 and 23, 1879. Tires of fine-grained iron and puddled steel appear to be safer, while ingot steel offers greater advantages as to wearing.

ANNUAL REPORT OF THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.

Continued from Page 63.

ex-President Metcalf. and at his left, Vice-President Rodd, the keen, bright-faced young light of the Pennsylvania Company's draughting department. About the table were men whose thought, wedded to the product of Pittsburgh's great workshops, finds embodiment in a hundred enduring structural forms. There were bridge builders and machine makers and road builders and iron founders; thoughtful-looking men whose calling left its impress on their faces, and whose names are familiar in all parts of the country.

Having called the attention of all present by a smart rapping upon the table, President Gottlieb, in a few well-chosen words, asked the Society to give heed to the first toast. He proposed "Our Society," and called Mr. S. M. Wickersham to respond thereto. That gentleman reviewed briefly the elements contained in the society, the work which had been accomplished by the members, and the impress their labors had left on the varied industries of this city. The gentleman concluded by reference to the notable output attained by blast furnaces in charge of a member of the society, and alluded to the generosity of another member (A. Carnegie), who offers a quarter of a million to the city where his industries are located.

Ex-City Engineer Dempster was called upon to respond to the sentiment, "Our Ex-President." In so doing Mr. Dempster lapsed into verse, neatly embodying complimentary allusions to Mr. Metcalf.

That gentleman, greeted by cheers, rose to his feet and replied fittingly to Mr. Dempster's effort. He then gave a scientific analysis of the diagram handed him by Secretary Harlow, representing the table and the assignment of seats. This was followed by a forcible little speech on the evils of the lowest bidder system.

"Hammer and Tongs" was assigned Mr. Wm. Miller, the veteran of the Duquesne Forge. The speaker referred to the hammer of the ancients, traced its slow development and evolution until the advent of the Nasmyth hammer, many years ago. The gentleman had trudged miles in old Scotland to witness the first blows of the first Nasmyth hammer, and stated that, though 28 years ago Everson, Preston & Co. operated the only steam hammer in this city, he was proud to learn that there were 239 hammers hung in rolling mills, 219 in steel works, and 141 in forges and bloomeries, a total of 599 hammers; nod among them the Park hammer, the largest in the United States.

Mr. M. J. Becker, chief of the Engineering Department of the Pennsylvania Railroad, responded to the semi-facetious sentiment "Raillery." The gentleman held that the word given him was a queer one, and that the Committee on Toasts ought to be held accountable for such a selection. In fact, he disliked committees utterly, and had learned that the cleverest man, when he became a member of any committee whatsoever, straightway lost all his good qualities, becoming tyrannical, despotic and altogether hateful. He had just returned from a ten days' tour over the line of the Pan-handle road, and was in no fit condition to make a speech. If any member of the Society wanted to know what the speaker had to say about rails or railways, he would ask them to call at his office after 10 o'clock next day.

Wm. Thaw, Jr., rose to respond to the toast, "General Engineering." The speaker, as the chairman of the committee arraigned by Major Becker, asked a suspension of judgment on committees, and defended his committee's selection of the toast "Raillery." Mr. Thaw delivered a graceful and timely speech, and was warmly applauded.

"The Bridge of the Future" brought out a thoughtful and interesting address from Mr. G. Lindenthal. His views regarding the cause of deterioration of iron in bridges by oscillatory and vibratory motion were well expressed and were new to at least a portion of his hearers. The weight and speed of trains now called for special skill and care in the construction of bridges, and the speaker deprecated the prevailing ideas of railroaders to the effect that a long span iron bridge could be contracted for one month and finished the next. Mr. Lindenthal gave some interesting facts relating to his examination of portions of a bridge thirty-seven years old, showing the serious depreciation in the wrought-iron eye bars and little or no depreciation in the wire cables.

"The Press" was responded to by a representative of *The Telegraph* (from whose columns we take this report), after which Mr. Miller was asked to tell what he knew about "cranks," on the ground that the gentleman's years of experience in forging them entitled him to an inside track towards information. Mr. Miller remarked that as a rule cranks should be shrunk tight, have plenty of "throw" and a good "drop."

Capt. Paul Rohrbacher, being called upon to say something, delivered one of the best efforts of the evening, and concluded by earnestly advocating the establishment, in this city of great industries, of a technical school, on a scale commensurate with the peculiar needs of this community. The gentleman was warmly applauded. Mr. C. H. Kloman yielding gracefully to the combined pressure of the Society's members, sang Foster's "Swanee River," followed by "John Brown's Body," in both songs having the hearty support of the Society lungs and larynxes. It being then past midnight the banquet ended.

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RECENT INVENTIONS.

A new method of opening up channels through sand bars consists in driving a number of piles along the course of the desired channel. It is asserted that the action of moving water against and around these piles will effectually remove and wash away the sand.

While the memories of the railroad accident at Spuyten Duyvil Creek are fresh in the minds of the people, increased importance will be given inventions which will lessen the danger to travelers. A novel invention of this class consists in combining with the semaphore arm or other visual signal, a rotating arm, arranged when a switch is misplaced to lie across the path of an audible signal on the locomotive. When the visual signal is at "danger" an alarm will be given upon any passing locomotive.

A new lock and signal for railroad draw-bridges consists of spring-impelled bolts arranged on either end of the draw, and having connecting rods attached to the bolts at one end, and at the other, respectively, above and below the pivotal point of a centrally-arranged lever and rack bar. These locking bolts work in mortises in the draw-bridge abutments. When the draw is open, gravity signals suspended over and to the side of the track fly to "danger." The return of the draw to its normal position serves, through the action of the bolts, to return the signals to "safety" position.

A late invention in electrical railways for street cars provides a street car with an electro-motor in connection with a suspended insulated wire over the track and above the car, and with an electro-generator located at some point along the line. A sheave is arranged to travel on the suspended wire, and has a depending wire connecting said sheave and the electro-motor on the car, the wire serving to transmit the current to the car. One of the track rails serves as a return conductor.

Another means for providing additional protection to travelers consists of maintaining a break in one of the rails of a siding, whereby shunted cars are prevented from returning and fouling with the main line. The rod operating said spring-rail has a spring connection, whereby, if the switch were reset to the main line before the car in shunting had reached and passed the break, the wheels of the car would spring said rail into line when merely passing.

A novelty in the construction of passenger locomotives consists in arranging the driving-wheels above the track in such manner that they rest upon and between smaller truck wheels, and to which they communicate motion through frictional contact. This construction admits of a higher degree of speed than is attainable under the ordinary arrangement of driving-wheel.

We chronicle this week an invention designed to do away with the vibrating diaphragm of the mouth-piece of a telephone, which will be, perhaps, interesting to the readers of this paper. A thin sheet of resonant metal, susceptible of magnetic induction, is bent into conical or funnel shape, with two of its edges in close proximity, but not meeting. A helical wire is wound on one of these edges, parallel thereto, and connecting with the main line. This construction, it is said, admits of the transmission and reception of articulate speech, without the employment of a diaphragm.

F. B. Brock.

CORRESPONDENCE.

METRIC PROFILE PAPER.

Boston, Feb. 7, 1882.

Editor Engineering News:

In a letter published in your paper of Jan. 7 last may be found some suggestions concerning the ruling to be used for metric profile paper. The designs there described are, however, not sufficiently general in their application, neither are they based upon sound *decimal* principles, being adapted to the use of the 25 meter chain, which does not belong to the standard linear measures of the metric system, as was explained in your number for Jan. 28.

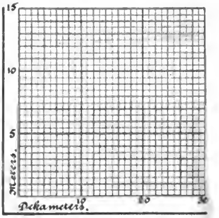
Let us examine the subject from a purely metric stand-point.

It is for many reasons desirable that the different designs of metric profile and cross-section paper should be as few as possible. This may be best accomplished by giving to each design a purely decimal character, so that it may be used for a variety of different scales and ratios of distortion, giving especial prominence to those scales that are most commonly employed.

The valuable principle of doubles and halves, described in your issue of Jan. 28, upon which the standard series of metric measures is based, is also extended to the draughting scale, and the half centimeter, centimeter and double centimeter, with their sub-divisions of millimeters, half millimeters and double millimeters, although not embracing all the metric draughting scales, are probably used more commonly than any other.

Profile and cross-section papers are draughting scales in their nature, and by limiting them to designs based upon the half centimeter, the centimeter and the double centimeter, most, if not all, of the wants of railroad engineering, hydraulic engineering and general physical experiments will be met.

The metric profile paper already published by J. W. Queen & Co. furnishes, in the most perfect manner, the scales of the half centimeter and the centimeter; no profile paper based on the double centimeter seems, however, to have been published in this country, and the following design is recommended to supply the want:



The lines of the diagram are two millimeters apart, both horizontally and vertically, every other line being slightly heavier and every tenth line still heavier. This ruling brings out squares of two centimeters in strong relief, while the intermediate ruling favors the use of the standard 20 meter chain in railroad work. The numbering of the lines in the diagram is such as to make a horizontal scale of 2 centimeters to 100 meters, or $\frac{1}{5000}$, and a vertical scale of 4 millimeters to 1 meter, or $\frac{1}{250}$, making a distortion of 20 to 1. These are the scales contemplated by the writer of the communication in your issue of Jan. 7, and, as is there shown, are very nearly the same as those commonly used with measures in feet.

The diagram may also be figured, in each direction, for either of the following scales, referring to natural size,

$\frac{1}{2}$, 1, $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{100}$, $\frac{1}{200}$, $\frac{1}{1000}$, $\frac{1}{2000}$, etc.

By variously combining the horizontal and vertical scales, work may be plotted to a *natural scale* or with such distortions as 5 to 1, 10 to 1, 20 to 1, etc.; a range of possible combinations that would seem to meet any ordinary case.

Profile paper of this kind, together with the kind already published by Mr. Queen, would seem to the writer to meet all the ordinary cases of civil engineering. As both designs are purely decimal in each direction they may also be used as cross-section paper if desired—a very valuable simplification of engineering stationery.

Charles H. Swan.

CENTER OF GYRATION.

A correspondent asks the meaning of the term "radius of gyration," in the denominator of the fraction expressing the compressive strains in columns or struts.

According to Rankin (Applied Mechanics, p. 361), "the additional strain due to direct pressure is in a ratio which increases as the square of the proportion in which the length of the pillar exceeds the *least diameter*, or" $\frac{l}{h}$. And in Gordon's formula, so-called, h is taken "to represent the diameter of a pillar or strut in that direction in which it is most flexible." We judge that h in the formula of our correspondent, is the h of Gordon, which some wiseacre has chosen to characterize as the "radius of gyration."

RANDOM LINES.*

BY R. L. MORRISON, C. E., KNIGHTSTOWN, IND.

GENTLEMEN: Had there been any ready method of computation of departures, suitable for work in the field laid down in any of the text books on surveying—in the manuals or engineers' pocket-books—in Molesworth, Haswell, Trautwine, Nystrom or Burt's "Key to Solar Compass," there might have been no occasion for the reading of this paper. With incomplete exceptions, such as the short rules and table in Burt's "Key," published in 1854, and possibly others in manuals published since, which I have not seen, the subject of random lines has been left unnoticed. This is much as the books leave the truth in reference to triangles, viz., *that the line between the middle points of any two sides of any plane triangle is parallel to the third side, and is equal in length to half of it.* The reason why text-books have so carefully refrained from any mention of this fact was, for a long time beyond my comprehension, for it is absurd to think geometers had never made note of it. About ten years ago I stumbled upon it, and thought I had really found something. It has taken nearly all the years since for me to fully appreciate the utter insignificance of the discovery. They may have omitted to mention it because it was so extremely apparent that it would occur at once to the mind of every investigator! Be that as it may, let pupils who do not catch it at once be "bored for simples." If you choose, yet the fact remains that such an apology for failure to insert will not apply to the authors of the pocket-books mentioned, for insignificant items by the score swell out their volumes and are welcomed, in place, as entertaining or useful in assisting the memory to recall points almost forgotten. The County Surveyor would, doubtless, also welcome instructive items relative to random lines.

For the purpose of assisting those surveyors who may not have given the subject so much attention, as an aid to tiresome mental work in the field when tables may not be at hand: to remove the cause of much possible inaccuracy, and because of the failure of the published works to supply the need, have I ventured to furnish you with reliable and simple rules for field practice on random lines. I hope the older surveyors present will pardon me for demonstrating matters as to the process of their formation, which they may already so thoroughly understand.

The old text books on surveying give the departure 2⅓ links, in distance of 80 chains (1 mile), for an angle of 1 minute; and it is now my purpose to show you what each member could as readily show himself, to wit.: How near 2⅓ links departure is to the absolute truth. "The radius of a circle being 1, the semi-circumference is known to be 3.14159265358979. This being divided by 180 and 60, or at once by 10800 gives .0002908882086657 for the arc of 1 minute. Of so small an arc, the sine, chord and arc differ almost imperceptibly from the ratio of equality."—Legendre.

Now, in order to simplify the discussion, I shall here consider a link as if it were the unit instead of only the hundredth part of the unit. The sine, then, for arc of 1 minute, for 1 chain distance, expressed in links, will be .02908882086657, and for 80 chains it will be 80 times that much, or 2.32710566932560.

2⅓ links is	2.33333333333333
Natural sine arc 1' for 1 mile as above.....	2.32710566932560
The difference is, ...	.00622766400773

or say $\frac{6}{1000}$ of a link, or .06 of a tenth of a link. This is nearly the sixteenth part of a tenth of a link as the difference for each minute of angle in a distance of 1 mile. Up to 1°, however, or 60 times the above difference, the difference is less than four-tenths of a link, and it is found from the carefully calculated tables of the books (the departures being given for but two places of decimals) that the departure for distance 40 chains, and for angle 1°, does not vary in the slightest particular from the departure worked out by the short method given below, the rule for which is made by assuming that 2⅓ links is the true sine of angle of 1 minute in 1 mile. It is therefore unnecessary to use the long-drawn-out fractions where simpler forms can be substituted without inaccuracy.

If, then, the difference for 1° and 1 mile is four-tenths of a link, for 2° it would be eight-tenths link, therefore the short rules given below hold good for all angles up to 1° only. When angles are larger than 1° they pass out of the range of angles for ordinary random lines. Sometimes, however, in field work, larger ones are unexpectedly met with, and it is just here the importance to the surveyor of having at hand a ready method of computation becomes apparent. Such angles may be correctly and almost instantly computed up to 4° by General Rules A and B.

WHEN MINUTES OF ANGLE ARE GIVEN, TO FIND LINKS OF DEPARTURE.—If 2⅓ links be taken as the departure for one minute in 80 chains, for 40 chains there will be 1⅙ links; *i. e.*, 1 minute = 1⅙ link; therefore, the

Rule for 40 Chains.—To the number of minutes add ⅙ to get number links departure. Good for all angles up to 60 minutes.

[This rule I do not find anywhere, though it would be strange if it had not sooner been published.]

General Rule (A).—Multiply .0291 by given distance in chains and links, then multiply by given number of minutes to get number of links of departure.

Good for all angles up to 240 minutes.

Example.—The angle of two lines starting from the same point is 240 minutes. How far apart should they be in 100 chains?

.0291 × 100 × 240 = 698 links.—Ans.

NOTE.—In cases where extreme accuracy is desired, a proper allowance can be made for the difference in length of the random and the true line, equal to the versed sine of the included angle. In distance of 40 chains and angle of 4°, it is 9$\frac{74}{100}$ links; *i. e.*, the true line will be 9¾ links longer than the random line if the right angled departure be projected from the latter line; if it be from the true line, however, the versed sine becomes subtractive from the measured distance. For 3° the versed sine, 40 chains distance, is 5½ links; for 2° it is 2½ links; while for 1° it is scarcely ⅔ of a link. I have fixed upon 4° as the highest limit of angles necessary to be considered in a treatise on random lines.

Short Rules for Special Distances.—Good for all angles up to 60 minutes.

For 40 chains—Add ⅙ to the number of minutes to get number of links of departure.

For 20 chains—Add ⅙ to the number of minutes and divide by 2 to get the number of links of departure.

For 10 chains—Add ⅙ to the number of minutes and divide by 4 to get the number of links of departure.

For 1 chain—Add ⅙ to the number of minutes and divide by 40 to get the number of links of departure.

General Short Rule.—Good for all angles up to 60 minutes.

Multiply the result obtained as above for 1 chain by any given distance in chains and links to get the number of links departure for such distance.

Example.—Given distance 18.35 chs., angle 24 minutes. Required links of depature?

24 + 4 = 28, ÷ 40 = 0.7, × 18.35 = 12.845 links.—Ans.

When Links of Departure are given, to find Number of Minutes of Angle.—In the equation 1⅙ link = 1 minute, the value of 1 link, expressed in minutes, must be obtained. Then if 1⅙ link = 1', $\frac{7}{6}$ lk. = 1', or ⅙ lk. = ⅐, or $\frac{6}{6}$ lk. = $\frac{6}{7}$', *i. e.*, 1 lk. = $\frac{6}{7}$', or $\frac{7}{7}$ lk. = $\frac{6}{7}$, where both terms are in the same denomination. Hence the

Rule for 40 Chains.—From the number of links departure subtract ⅐ to get number of minutes of angle. Good for all departures up to 70 links.

[This rule is given in Burts "Key" without explanation of its formation. His limit is 200 lks. per mile].

The general rule, which I do not find stated anywhere, is as follows, viz:

General Rule (B.)—Multiply distance in chains and links by .0291 and divide product into the given number of links, to get the number of minutes of angle.

Good for all departures which do not produce angles greater than 240 minutes.

Example.—The departure of two lines starting from the same point in a distance of 100 chains is 698 links. What is the angle?

.0291 × 100 = 2.91, 698 ÷ 2.91 = 240'.—Ans.

Reference to traverse table for distance 100 and angle 4° will show the correctness of general rules A and B in the examples given.

Short Rules for Special Distances.—Good for all departures which do not produce angles greater than 60 minutes.

For 40 chains—From links departure subtract ⅐ to get number of minutes of angle.

For 20 chains—From 2 times links departure subtract ⅐ to get number of minutes of angle.

For 10 chains—From 4 times links departure subtract ⅐ to get number of minutes of angle.

For 1 chain—From 40 times links departure subtract ⅐ to get number of minutes of angle.

General Short Rule.—Good for all departures which do not produce angles greater than 60 minutes.

Obtain result for distance of 1 chain, as above, and divide it by any given distance in chains and links, will get the number of minutes of angle.

Example.—Given distance 30 chains, departure 21 links. What is the angle?

(21 × 40) — ⅐ = 840 — 120 = 720, ÷ 30 = 24'.—Ans.

From the rules here given tables for instant reference can be constructed by any surveyor to any desired extent of completeness; or he can, without tables and without loss of time or danger of inaccuracy, make such computations in the field as may be necessary for any random line.

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[*] Remarks on methods of computing minutes of angle from the number of links of departure and, vice versa, departure from angle, together with an extraneous observation on triangles. From a paper, the main part of which was read before the Indiana Association of County Surveyors and Civil Engineers at their second annual meeting in Indianapolis, Jan. 18, 1882.

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ELECTRICITY VERSUS GAS.

About five years ago I pointed out that land would fall in value. It seemed to me evident that this would be the case, because larger and larger tracts of Western prairie were each year being converted into great corn farms, and the means of transport of this corn to our ports were each year rendered more easy. No one, however, believed me before the event proved that I was right, for one of the peculiarities of the English mind is, that it can never realize that what is will ever cease to be, until the "will be" has become the "is."

When Edison made his discoveries in electric lighting, again I raised my voice, and said—or, to put it more accurately, again I raised my pen and wrote—that the wise who held gas shares would do well to sell them. Edison's invention was not perfected. Gas directors jeered at it; it would never be more, they said, than a pretty theory; and even if it were to vanquish gas as a lighting medium, the companies would sell as much gas as they do at present for heating purposes, and this, with the sale of their "residual products," would secure to them as good profits as heretofore. Now, I was as well aware as others that the idea of lighting by electricity had not as yet assumed a clear, practical form, but I knew that the minds of so many would be devoted to giving it that practical form, that in the end they would succeed; while, as to selling gas for heating purposes and selling "residual products," I had calculated the results and knew what they were.

Let those who hold the shares of gas companies ponder over the following facts and figures. If they regard them as incorrect then let them keep their gas shares. If, on the other hand, they arrive at the conviction that they are correct they will take advantage of the folly of the mass of mankind and accommodate some fool with their shares before the collapse comes.

The mode in which electrical light is produced is very simple and can easily be comprehended when explained in plain and unscientific language. If you move a wire near the poles of a magnet, backwards and forwards, along what are called its lines of force, a current of electricity is attracted to the wire, and runs from one end of it to the other, provided there be a complete circuit. The strength of the current is in proportion to the size of the magnet and to the velocity with which the wire is moved across the "lines of force." Having got a magnet and a wire, the next thing, therefore, is to adapt motive power to them, which moves the wire quickly—that is to say, to a steam engine. The engine, wire and magnet together, then, form a machine which is called a "generator." With its aid, a stream of electricity is thrown into the wire. Now, if the wire be cut at any place, and then the interval between the two points be bridged over with a filament of carbon, the electricity passing through the carbon becomes incandescent. This constitutes the incandescent lamp. The carbonized filaments are enclosed in globes of glass in which there is no air, and in which, consequently, the filament lasts for several months without being destroyed. There are other systems, all based upon one principle and called "the arc," in which the electricity leaps from one stick of carbon to another, and in which the sticks burn like candles. In street lighting the arc is used, and, light for light, it is cheaper than gas. In the city the electric companies that light the streets are paid what the gas companies were, and for this they supply four times as much light. Gas is used to work the generators, but the amount of gas which would maintain a light of 12-candle power, employed in turning a generator, produces an arc of 1,600-candle power. If the same engine were employed to supply the incandescent lamps, the same quantity of gas would produce 12-candle power lamps, with an expenditure of a sixteenth part of the gas now requisite for this. The reason of this is that incandescent lamps have to be worked at a much lower temperature than arc lamps.

Electric light supplied to houses ought not to be, even in the present condition of the light, dearer than gas. Mr. Edison is now laying down 300 miles of electric light mains in New York City, and he will light every house with his incandescent lamps at the price which the owners are now paying to the gas companies. As a matter of fact, however, the light can be produced, as soon as mains are laid down, at a far less cost than gas.

The present condition of the electric light in London is: Streets are now being lighted with it at one-fourth of the price of gas; incandescent lamps can be introduced into every room of any house so soon as the mains are laid: there can be a separate meter to each house; the lamps can be separately lighted, and put out by turning a cock; if one light goes out, no other one is affected; the sub-division is so complete that there is no glare, and yet a room with incandescent lamps is far more brightly lighted than with an equal number of gas lamps; and an equal amount of candle-power produced by electricity is cheaper than an equal amount produced by gas. In addition, the electric light has no odor, it does not vitiate or heat the air, nor does it, like gas, tarnish paint and decoration.

Are we than seriously to believe that electricity will not replace gas for lighting purposes? When railroads were in their infancy there were many who refused to believe that the public would seriously prefer them to the good old coaches. Yet the coaches have disappeared in favor of the railroads. So it will be with gas. We use this foul product because its advantages have outweighed its disadvantages. We are, however, not blind to the latter. If we can find something which will secure to us still greater advantages, and which will be without its disadvantages, can any one suppose that we are so enamored with the heated atmosphere, with the foul smell, and with the destructive properties of gas, that we shall continue to light our rooms with it?

In order to realize what a gas company is, and what its prospects will be when electric light is substituted for gaslight, it is only necessary to analyze the accounts of a company, and as the Gas-Light and Coke Company is the most important London gas company, I will take its published accounts for 1880 in preference to any other.

This company has a capital consisting of debentures, and of various denominations of shares, in all amounting to £9,277,122. Its revenue for the year was £2.612,566, derived from the following sources: Gas, £1,984,019; residual products, £585,480; meters, £37,818, and sundries £5,260. Its expenses were £1,712,656, and consequently its net revenue were £899,910. The capital is probably about £3,000,000 above the real amount for which all its plant might be brought into existence, and its net revenue might be increased by about £50,000 were its resources economically administered, for in its debtor account I see that the directors receive £7,000, its law expenses are £4,669, its bad debts are £11,871, its collectors receive a commission of £24,707, and its superannuation and annuties amount to £17,969, while all other items are upon the same astounding scale.

It is clear that were the Company to pay 5 per cent. all round on its capital and on its debentures, its profit would not be too large a one. This it might do, were its net revenue reduced by £463,856, and, as it receives for gas £1,984,619, it practically receives from gas consumers about 9d. per thousand cubic feet above what it ought to; and, were the works the property of the local authorities, and made with capital obtained at 3½ per cent., its present charges are about 1s. per thousand cubic feet beyond what would be required. In these estimates, I accept the preposterous capital and the preposterously wasteful annual expenditure of the Company, although, as I have already said, both are excessive.

Now, let us see what would be the effect on the company of the substitution of electricity instead of gas for lighting purposes. To produce the electricity, one-sixteenth portion of the gas now used for lighting would be required. Therefore, if the company were to depend upon this income it would be ruined. It would consequently be obliged to endeavor to sell its gas for heating purposes. About the financial effect of this to a company much nonsense is talked by chairmen and directors of companies. It is said that the demand would be so great that the saving in purification would be so enormous, and the profit from the residual deposits could be so increased that the profits of the companies would be the same as they are now. A few considerations and a few figures will dispel this illusion.

A gas company has now to produce gas free from impurities and with a 16-candle lighting power. It sells this gas at 3s. 2d. to 3s. 4d. per thousand cubic feet, because it has a monopoly, and because, even at monopoly price, gas is the cheapest illuminating power now on sale. If it were to sell for heating purposes it would have to compete with coal, and would have, consequently, greatly to reduce its selling price; moreover, it would have entirely to give up selling for lighting purposes, for the purified gas and the unpurified gas obviously could not pass through the same mains. I do not myself believe that gas ever will be extensively used for heating purposes, because habit in these matters is everything, and it will be long before the habit of open coal fires disappears. But I will assume that double the amount of gas is sold for heating purposes that is now sold for lighting and heating purposes, and that this is brought about by a reduction of one-half on the cost. The debit account would be reduced by £47,968 for purification, and increased by £907,086 for double the amount of coals, and by £163,877 for carbonizing, and would therefore be £3,383,563, instead of £1,712,650. The credit account would be increased by £586,180 for residual products, making it £3,519.602, instead of £2,612,566. Consequently the net revenue would be £136,089, instead of £899,910. It will be observed that in this estimate I make no allowance for the interest on new capital requisite to increase the works so as to double their production, or for an increased staff of engineers, etc., all these being supposed to be met by economy in the present wasteful revenue expenditure. Moreover, as the substitution of gas for coal would be very gradual, and probably never could take place to any extent, were not the price of gas reduced by three-quarters instead of one-half, it is clear that the condition of the company, when electricity is in general use, for lighting purposes, will not be nearly as prosperous as the above calculation supposes.

There are no valid patents that stand in the way of producing the electric current, connecting it with lamps in the streets and in houses, and making the arc and the incandescent lamps. If the right to lay mains under the streets be granted to any particular electrical company, that company would have a practical monopoly, for it is clear that it would be impossible to allow rival companies to take up the streets at their pleasure. No company should, therefore, be given these powers.

For years we have regretted that the supply of gas has been in the hands of private companies. These companies have been allowed to charge rates to secure to them a net 10 per cent. profit on outlay, and they have enjoyed a monopoly. The consequence has been that the outlay has been reckless, that revenue has been squandered because there has been no control over it by the householders who have had to pay for it, and that the companies and their officials have regarded their customers much as a feudal lord in the middle ages regarded the wretched serfs attached to the glebe. We must not again fall into the same error. Electric lighting must be for householders and by householders. The amount necessary for plant and working capital must be raised at 3½ per cent. on the security of the rates, and the lighting of the metropolis must be in the hands of the representatives of the ratepayers. We have, alas, no metropolitan municipality. The only body that can take this matter in hand is the Metropolitan Board of Works. What it ought to do at once is to appoint a commission of men of science and of practical business men, who would report upon the amount necessary to lay electric mains, to distribute generators, etc., and also the price that would have to be charged for the supply of the light to cover interest on outlay, depreciation and working expenditure. Having acquired this knowledge, it should bring a bill into Parliament in the session of 1882 to acquire powers to light with electricity the whole of the metropolis under its jurisdiction.—*London Truth.*

CORRESPONDENCE.

WIND PRESSURE ON BRIDGES.

CHIEF ENGINEER'S OFFICE,
CHICAGO & ALTON R. R.,
CHICAGO, Feb. 25, 1882.

EDITOR ENGINEERING NEWS:

It is with regret that I have been obliged, through press of business, to leave unanswered until this late date the requests made to me to publish stress-sheets, showing the percentages of increase due to wind pressure in the stresses in the various members of a through and of a deck bridge, which, in my communication in ENGINEERING NEWS of Aug. 20, 1881, I signified my willingness to do.

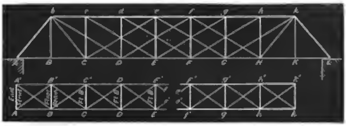
Since it is universally acknowledged that the effect of wind upon a bridge is to increase the stresses in some of its members, it remains to be determined in which members the percentages of this increase are sufficiently large to merit being taken into consideration. There being no law fixing that percentage above which the increase must invariably be taken into account, the standard must be fixed in each case by the engineer. This is, therefore, a matter of judgment. In this office we deem any increase worthy of consideration.

The fact that it takes nearly three times as much work to take the wind stresses into consideration by the method given in ENGINEERING NEWS of Aug. 20, 1881, as it does to compute the stresses due simply to rolling and constant loads, may lead some—especially contractors filing large numbers of stress-sheets in competition with others—to consider that it is better and cheaper, in point of time and labor saved, for them to either neglect altogether the stresses due to the action of the wind, or else, when an increase of section to withstand wind pressure is called for in the specifications, to simply guess at the amount necessary. Such arguments, however, do not impeach the method, nor do they show that the required increase of section can be obtained by the "rule of thumb" so accurately as it ought.

I have the pleasure of submitting three condensed stress-sheets, each for a span of 160 ft. center to center of end pins, and all having the

STRESS SHEETS, SHOWING PERCENTAGES OF INCREASE IN STRESSES DUE TO WIND PRESSURE.

Through Span.



TENSION.

NAME.	MAXIMUM STRESS Without wind pressure. Lbs.	 With wind pressure. Lbs.	Percentage of increase.
A B	107,544	L 116,484	8.2
B C	107,544	L 141,880	31.9
C D	161,316	L 223,674	38.8
D E	215,108	L 296,134	37.6
E F	268,870	L 362,210	34.7
B b	45,330	L 50,304	11.0
C b	97,178	L 108,232	11.4
D b	86,875	L 95,708	10.2
E c	70,327	L 78,128	11.1
F d	33,096	L 35,280	6.6
G e	22,064	L 23,520	6.6
H f	11,032	L 11,032	....
K g		....	....
k K'	....	7,284	
h g'		4,856	
g f'		2,428	
f e'		......	
B A'		35,676	
C B'		27,748	
D C'		20,811	
E D'		14,865	
F E'		9,910	

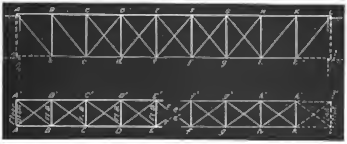
COMPRESSION.

NAME.	MAXIMUM STRESS Without wind pressure. Lbs.	 With wind pressure. Lbs.	Percentage of increase.
A b	210,918	L 238,925	13.2
b c	215,108	L 238,948	11.0
c d	268,870	L 291,480	8.1
d e	268,870	L 290,020	7.9
e f	268,870	L 288,290	7.2
C c	45,361	L 50,391	11.1
D d	21,247	L 22,766	6.6
E e	14,233	L 15,170	6.6
k k'		5,957	
h h'		5,106	
g g'		3,404	
f f'		1,702	

same number of panels. One is a through Whipple truss, and the other two are deck Pratt spans; one of the latter being swung from the top chords, the other from the bottom chords. According to the sheets the maximum stresses in some of the members of a given span occur in the leeward truss, while at the same time the maximum stresses in other members occur in the windward truss. Thus, in the case of the deck span swung from the bottom chords, the maximum stresses in the bottom chords, main ties and posts are found in the leeward truss, while those in the counter-ties and top chords are in the windward truss. This disposition of the maximum stresses varies with the style of bridge, *e. g.*, the maximum stresses in the posts of the deck span swung from the bottom chords occur in the leeward truss, while those in the posts of the deck span swung from the top chords are found in the windward truss.

It is seen that the percentages of increase vary greatly with the style of the span. This is owing to the fact that it depends on the style of the span whether the stresses in a given member arising from wind pressure do or do not act in conjunction with each other and with the stresses due to the moving and the fixed loads. The maximum stresses in the chords do not necessarily occur in the center panel, but may be found in the panel next to the center one. The difference in the maximum stresses in the chords of the center panel and of that next to it is usually, however, very slight.

Mr. Cain in his communication in ENGINEERING NEWS of Oct. 29, 1881, remarks that the formula given by Mr. Gottlieb in your issue of Sept. 17, 1881, and indorsed by myself, is less accurate than that given Aug. 20. I still consider one formula as accurate as the other, since either can be transformed into the other by the proper substitution. (*D* in the formulæ given Sept. 17 = *g* in those of Aug. 20, and $\frac{1}{2} g \frac{\tan. B}{\tan. L}$ in the former = *x* in the latter.) As to the relative convenience of the two formulæ in practical work engineers may differ.



Deck Span Swung from Top Chords.

TENSION.

NAME.	MAXIMUM STRESS, Without wind pressure, Lbs.	MAXIMUM STRESS, With wind pressure, Lbs.	Percentage of increase.
b c	131,752	L 125,504	......
c d	230,566	L 233,552	1.3
d e	296,442	L 302,552	2.0
e f	329,380	L 337,122	2.3
A b	221,196	W 224,064	1.3
B c	170,321	W 172,181	1.1
C d	123,870	W 124,431	0.4
D e	81,843	L 82,872	1.2
E f	44,240	L 47,150	6.5
F g	11,061	L 16,143	46.2
G h	−17,694	L 10,140	42.6
H k	−42,025	L 31,728	24.5
k h'		8,307	
h g'		5,578	
g f'		2,760	
f e'		......	
A' B		37,118	
B' C		28,808	
C' D		21,651	
D' E		15,405	
E' F		10,310	

COMPRESSION.

NAME.	MAXIMUM STRESS. Without wind pressure, Lbs.	MAXIMUM STRESS. With wind pressure Lbs.	Percentage of increase.
A B	131,752	W 159,900	21.3
B C	230,566	W 279,825	21.3
C D	296,442	W 359,773	21.3
D E	329,380	W 394,770	19.0
E F	329,380	W 394,760	19.0
B b	177,800	W 180,096	1.2
C c	133,350	W 135,072	1.2
D d	88,900	W 90,048	1.2
E e	44,450	W 45,024	1.2
k k'		6,846	
h h'		5,868	
g g'		3,912	
f f'		1,956	
A A'		29,296	

Deck Span, Swung from Bottom Chords.

TENSION.

NAME.	MAXIMUM STRESS. Without wind pressure. Lbs.	MAXIMUM STRESS. With wind pressure. Lbs.	Percentage of increase.
a b	...	......	......
b c	131,752	L 153,886	16.8
c d	230,566	L 263,818	14.4
d e	296,442	L 346,206	16.8
e f	329,380	L 384,740	16.8
A b	221,196	L 245,016	10.7
B c	170,321	L 188,513	10.6
C d	123,870	L 136,653	10.3
D e	81,843	L 89,344	9.4
E f	44,240	L 47,150	6.5
F g	11,061	W 12,651	14.4
G h	−17,694	W −11,895	32.7
H k	−42,025	W −32,308	23.1

COMPRESSION.

NAME.	MAXIMUM STRESS. Without wind pressure Lbs.	MAXIMUM STRESS. With wind pressure. Lbs.	Percentage of increase
A B	131,752	W 144,004	9.3
B C	230,566	W 252,007	9.3
C D	296,442	W 324,000	9.3
D E	329,380	W 355,010	7.7
E F	329,380	W 355,010	7.7
A a	200,025	L 221,380	10.7
B b	177,800	L 196,960	10.7
C c	133,350	L 147,720	10.7
D d	88,900	L 98,480	10.7
E e	44,450	L 49,240	10.7

The annexed stress sheets are based on the method for calculating wind-pressure stresses given by me in ENGINEERING NEWS of Aug. 20, 1881. The letters "L" and "W" in the columns of maximum stresses indicate whether the stress occurs in the leeward or in the windward truss.

Through Whipple Span.

Length of span, center to center of end pins	160	ft.
Panel length	17.78	ft.
Trusses apart, center to center of chords	17.5	ft.
Depth of trusses, center to center of chords	30	ft.
Rolling load per lineal foot	3,000	lbs.
Constant " " " "	1,500	lbs.
Surface exposed to wind by rolling load per lineal ft. of bridge	8	sq. ft.
Distance above top of stringer of center of gravity of rolling load	8.1	ft.
Total surface actually exposed by one truss to wind pressure	638	sq. ft.
Wind pressure per sq. ft.	32	lbs.

The total surface exposed by both trusses to the wind, when span is covered with the rolling load, is taken at 50 per cent. greater than that exposed by the windward truss.

Deck Pratt Spans.

Depth of trusses center to center of chords	21	ft.
Constant load per lineal foot	1,400	lbs.
Total surface exposed by one truss to wind	550	sq. ft.
" " " " both trusses to wind	1,100	"

Remaining data same as for the Whipple span.

The percentage of increase in the moment on the floor beams is 5.5 per cent., that on the stringers 2.7 per cent., and the increase in the stress in the floor-beam hangers of the through span is 5.4 per cent.

E. J. WARD,
Asst. Engr. C. & A. R. R.

ADJUSTMENT OF GRADES TO CURVES.

NORTHERN PACIFIC RAILROAD CO.
CONSTRUCTION DEPARTMENT,
YELLOWSTONE DIVISION,
GLENDIVE, Mont., Feb. 18, 1882.

EDITOR ENGINEERING NEWS:

Having just read with great interest "Adjustment of Grades to Curves," by H. A. McClellan, Chief Engineer Nevada & Oregon Railroad, I think it may possibly interest some of your readers to see a formula to the same purpose already used for some years on the European continent.

The curve resistance, indeed, depends upon so many circumstances as wheel-base, construction and condition of rolling stock, radius of curve, condition and form of rail, play between rail and wheel, heightening of outside rail, velocity, and length of train, etc., that it is not at all surprising to find the many existing formulæ for curve resistance, derived as well from theoretical reflections as from practical experiments, differing—to say the least—so very much from each other.

Thus Hensinger von Waldegg, Chief Engineer in Hanover, gives in his "Handbuch für Specielle Eisenbahn-Technik" (Leipzig, 1877) as an average value of many much differing experimente the following as curve resistance:

Radius in meter.	Curve resistance in kilogram per ton.
600	0.5
500	1.2
400	2.3
300	4.0

Cut says, at the same time, that this valne probably is too high, and suggests that the following is more correct:

Radius in meter	Curve resistance in kilogram per ton.
600	0.1
500	0.8
400	1.7
300	3.0

Scheffler gives (I don't remember in which of his books) the following practical formula, generally used on the European continent, for adjusting a grade to a curve:

$$\frac{1}{x} = \frac{1}{n} - \frac{1}{1.31\,r}$$

$\frac{1}{x}$ being grade through curve in resistance = the grade $\frac{1}{n}$ on straight line, and *r* being radius in meter. Taking *r* in feet instead of in meter, the formula will be:

$$\frac{1}{x} = \frac{1}{n} - \frac{1}{0.4\,r}$$

which gives the equivalent grade in feet per 100 feet $= \frac{250}{r}$

The difference between Hensinger von Waldegg's statements of curve resistance, above mentioned, seems to show that it is of no use to take into consideration the difference in gauge within the limits now used, at all events, from the present standpoint of experience; and we may, therefore, without further, be entitled to compare the results from Scheffler's formula with the table by Mr. McClellan and with that by George L.

Continued on Page 76.

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.

Tribune Building, New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR............ASSOCIATE EDITOR.

SATURDAY, MARCH 4, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

THE AMERICAN WATER-WORKS ASSOCIATION. The second annual meeting of the American Water-Works Association will be held in the City Hall, Columbus, O., on Tuesday, March 14, 1882. J. H. DECKER, Secretary.

CROTON AQUEDUCT.

The construction of the Croton Aqueduct was commenced in April, 1837, and the water was introduced into the city in July, 1842, or five years thereafter. The High Bridge over the Harlem River was not completed until 1848, the water being carried over the river in the meanwhile by iron pipes.

The dimensions of the masonry aqueduct as built have an extreme height of 101 in., and extreme width of 89 in. The length from the dam over the Croton River to the receiving reservoir is 38 miles, and descends with a grade of 13¼ in. to the mile. The top of the dam, which is 40 ft. in height, is 166 ft. above the level of high tide. About one-eighth of the line of aqueduct is in embankment. The least flow of the Croton River was then estimated at 27,000,000 of gallons daily, while the capacity of the aqueduct was stated as between 60,000,000 and 70,000,000 gallons daily. The area of the Croton Lake is 400 acres, and its capacity of storage was 500,000,000 gallons above the level at which the aqueduct would discharge 35,000,000 daily. The cost was about $9,000,000.

Owing to the method of construction of the conduit when above the natural surface of the ground (where for economy of cost the supporting walls were laid of dry masonry) the effects of frost and irregular settlement have resulted in opening cracks in the masonry extending for long distances, and have occasioned great trouble and expense, and no little risk of complete failure. The irregular settlement at these places has induced changes in the level of the grade, so that, if much over 100,000,000 of gallons is passed daily through the conduit it becomes filled and subjects the masonry to a strain from the pressure of the head of water which it was not intended that it should undergo, and adds another element of danger to the above enumerated.

This it is which renders the construction of a new aqueduct with the least possible loss of time, and in view of the increasing demand for water, a necessity. This has long been foreseen, and the authorities for several years past have been engaged in examinations and surveys with a view to determining the location and character of a new structure which, safe from the contingency of failure, shall be of sufficient capacity to carry water for long years in the future of the city.

On the occasion lately of the report of Hubert O. Thompson, Commissioner of Public Works, to the Mayor, we noticed briefly the characteristics of the new aqueduct which was proposed for the conveyance of the Croton water, and now from the report of the Chief Engineer, Isaac Newton, we append some interesting notes of the proposed work.

The existing storage resources on the Croton water-shed, natural and artificial, are as follows:

	Gallons.
Boyd's Corners Reservoir	2,727,000,000
Middle Branch Reservoir	4,004,000,000
Lake Mahopac	575,000,000
Lake Kirk	565,000,000
Lake Gleneida	165,000,000
Lake Gilead	380,000,000
Lake Waccabuc	200,000,000
Lake Tonetta	50,000,000
Barrett's Pond	170,000,000
China Pond	105,000,000
White Pond	100,000,000
Pine Pond	73,000,000
Long Pond	60,000,000
Peach Pond	230,000,000
Cross Pond	110,000,000
Haine's Pond	25,000,000
Reservoir on east branch of Croton now under construction	4,500,000,000
Total gallons	14,000,000,000

The following table shows the rain-fall and the average daily quantity of water running in the Croton River:

YEAR.	Rain-fall at Boyd's Corners Reservoir.	Average daily flow of the Croton River at Croton Dam.	Percentage of rain-fall running in the stream.
	Inches.	Gallons.	Per cent.
1866	51.77	440,705,558	51
1867	50.77	541,318,307	65
1868	50.38	600,724,104	74
1869	48.98	450,573,841	58
1870	44.63	347,685,318	47
1871	48.04	357,175,341	45
1872	40.74	307,208,408	49
1873	43.87	444,290,877	67
1874	42.37	427,018,306	63
1875	43.00	425,021,798	59
1876	40.68	367,872,898	56
1877	46.03	346,563,178	45
1878	54.14	462,854,308	52

In 1875 surveys and estimates were made under the direction of Gen. Fitz John Porter, having in view the erection of a dam on the Croton, north of the present dam, at an elevation of 30 ft. above the latter, from which two lines were surveyed, one passing down Sawmill River, the other, branching from the first, passes down the valley of the Bronx River. The first line was 14 miles of the distance in tunnel and the latter 10 miles of tunnel. For comparison with these two lines we have the line as proposed by Mr. Newton, which taps a reservoir on the Croton 4½ miles below the present Croton dam, formed by erecting a masonry dam 185 ft. in height and storing above the flow line of its aqueduct near 33,000,000,000 gallons, thus dispensing with any further storage reservoir on the Croton basin. The line is nearly direct from this reservoir as proposed, to the High Bridge, being but $\frac{1}{16}$ of a mile longer than an air line between these points, and is for about 25 miles in tunnel. This line is known as the Quaker Bridge line, and would require 3½ years to construct, and together with the Sawmill and Bronx River routes, are compared in the following table in their general outline and cost, extended from High Bridge to Central Park Reservoir:

	Quaker Bridge plan, 1881.	Sawmill River plan, 1875.	Bronx River plan, 1875.
1. Total length, miles	31.35	42.31	41.17
2. Capacity in million gallons daily	250	150	150
3. Total storage provided by plan in Croton Basin, with dams just high enough to fill aqueduct, million gallons daily	....	....	....
4. The same with dams, full height proposed, millions of gallons	32,000	....	....
5. Total cost, including no provision for storage	$12,000,000	$13,093,414	$13,719,520
6. Total cost, including provision for 32,000,000,000 storage	14,000,000	*19,493,414	*20,119,520
7. Cost of providing 32,000,000,000 gallons storage in Croton Basin	2,000,000	6,400,000	6,400,000
8. Area of new lake, including present Croton Lake, acres	3,635	1,200	1,200

* The same as No. 5, with $6,400,000 for storage added.

Table of Comparison of the Plans which have been proposed for an aqueduct from Croton Basin, terminating at High Bridge.

	Quaker Bridge plan, 1881.	Sawmill River plan, 1875.	Bronx River plan, 1875.
1. Total length from the Croton to High Bridge, miles	26.52	36.52	36.09
2. Capacity, U. S. gallons in 24 hrs., millions	250	150	150
3. Total cost with no additional storage	$10,000,000	$9,191,000	$9,818,104
4. Total cost with 32,000,000,000 additional storage in Croton Basin	12,000,000	15,591,000	16,218,104
5. Cost per million of gallons of supply obtained, including 32,000,000,000 additional storage in Croton Basin	48,000	103,946	108,121

The Housatonic line is not embraced in the above, as in the event of its ultimate use, it would be an auxiliary to either project. There is much interesting matter in the report of the Chief Engineer of a general nature, aside from its special reference to the proposed new aqueduct.

SENSATIONAL SCIENCE.

A correspondent misunderstands our article headed "Sensational Science" in the last issue of the NEWS, in that he mistakes the criticisms on sensational science as endeavoring to undervalue the labors of scientists performed in the interest of the public health, and very pertinently remarks "that the voluntary labors of our men of science in the direction of sanitary reform can have no other object than educating the people in principles which, if thoroughly understood and practiced, would tend to diminish very sensibly the ravages of preventable diseases."

In reply we would say that there can be but one opinion as to the value of modern scientific research in widening and extending the bounds of knowledge, and which calls for the hearty support of all interested, even in the slightest degree, in human progress; and we would be among the last to discourage or to disparage the labors of the true scientist in whatever line he may work. Without intending, however, any personal reflection on the scientists whose statements formed the basis of the article referred to, we must be permitted to remark that "they are not all Israel which are of Israel." The overshadowing importance attached to everything bearing on life and health, and the readiness of the average individual to seize and swallow, with but little discretion, whatever is offered for the benefit of either—and the votaries of no branch of science commanding so willing audiences as the sanitarians (and in none is the temptation for quacks to enter the ranks so strong)—that it cannot be denied that there is danger in the discovery that the art of making science sensational is a money-making one. And while this may be harmless as conducted by Mr. Richard A. Proctor, the astronomer, and others who could be named in some branches of science, it is far otherwise, however, in the one under consideration.

The various hypotheses for the spread of disease offer great facilities for this class of practitioners, and the germ theory, in particular, is the fruitful source of sensational writing. It is generally considered, by such as have acquired a right to an opinion on this subject, that it is more than probable no one of these hypotheses can be taken as true in all cases, but that there is a modicum of truth in each. Whichever theory, however, may be assumed as truth, experience has shown that, as an essential toward diminishing the ravages of disease, ventilation plays a most important part in modern practice; and in the treatment of the zymotic diseases, which are classed with the preventable, it is the sine qua non. Now ventilation is but dilution, and where this is applied in the proper place, we have the evidence that natural causes, so far from tending to increase the spread of disease, will, if properly availed of, furnish the most reliable means for staying its progress. Take the matter of sewer gas. It is undeniable that the putrefaction of animal and vegetable refuse produces a something which, if in sufficient *quantity*, and this is important to bear in mind, tends to plant the seeds of disease in various ways in the human organism. Now, whether this be a living germ, which as a species of parasite can multiply itself indefinitely under favorable circumstances, or whether it be of fungoid growth as was first supposed, and which gave the name to this class of diseases, science has established, and we think conclusively, that its generation is not spontaneous, but, "omne vivum ex ovo," and a vitiated condition of the atmosphere is essential to the incubation. Whatever may be the process, it is here and at this time that ventilation is beneficial, and a surrounding of free oxygen is antagonistic to the development of the germ. Hence that the organic compound called disease germs, whatever it may be, shall be deprived of its fecundating principle, it is only necessary that free oxygen should be present in sufficient quantity to break up and destroy its organic constitution, and to rearrange its elements into inorganic forms, inocuous and free from any quality dangerous to human life. Nature has provided the means, and man is only required to give them full scope, and this is insured by providing copious dilution, whether of pure air or water, preferably of both.

We have no reason to believe, on the contrary, are free from any suspicion whatever, that Mr. Falkard, Prof. Doremus or Dr. Parker had any intention of needlessly alarming the public in reference to the dangers with which we are surrounded, and which, if of the magnitude stated by them, it would be almost hopeless for us to attempt to shield ourselves against. We would much prefer to believe that, with preconceived ideas of what scientific research *should* develop, their sight was dulled to the apprehension of what really were the facts. What Mr. Falkard says as to the germs of disease, the concurrent testimony of scores of distinguished scientists and experimenters disproves entirely That Prof. Doremus blew out a candle by the mere force of his breath through a sonnd Philadelphia brick. This we do not believe, notwithstanding the report is so circumstantial. And when Dr. Parker says that diphtheria was not known in this city until the introduction of the Croton water, and that "it was solely caused by bad air from sewers" we can only say that his memory is at fault, for it is the testimony of equally careful observers that, before the introduction of the Croton, the city was ravaged yearly by deadly epidemics, believed to have been invited by the defilement of the wells then in use, by sewage and fœcal soakage, and no such visitation has occurred since.

We are greatly indebted to indefatigable scientists for the *truths* their researches bring to light, and we accept their statements, each in his own department, with the humility which becomes laymen; but when they indulge in inferences and deductions as the necessary results of these truths, outside and beyond their specialty, we question their infallibility, and claim an equal right to an opinion. As an illustration, an invention is shown us whereby sewer-gas may be kept out of the house, and the inventor has fortified his claim by the opinions of an M. D. We accept this indorsement so far as to the fact that it is desirable to prevent such gases from entering the house, but as to the efficacy of a given machine to effect that purpose we may question the fitness of the M. D. for the decision, without in any way questioning his professional skill as a physician.

If the errors which a special scientist may commit in this direction were confined to the bare incident itself, it would be a small matter, but here comes in the danger to this community. A fictitious source of disease could well be met by an equally fictitious remedy, and together they would prove efficacious, not in diminishing the death rate perhaps, but in leading the public to believe that the inroads of a fearful disease can only be averted by the use of a patented article which it behooves all householders to provide themselves. The illustration is used of a patented machine as one of frequent occurrence, but the same principle is applicable to cases where the injury done is not merely one of needless expense to the individual householder, but where a needless alarm is created over a wide district and where the sole remedy offered is one so radical and sweeping, involving possibly almost a reconstruction of the entire district, that the individual is powerless and must look to the authorities alone for succor. In the meantime, and waiting the action of the latter, the householder must bide his time with such patience as he may, bearing the horrors of a lingering death to himself or family contantly before his eyes. This condition of things is what we would be understood as deprecating—being the natural consequences of what we regard as "Sensational Science" when applied to sanitary matters in this city.

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DANGERS OF SEWER AIR.

On page 62, ENGINEERING NEWS, Feb. 25, in Sewerage of European Cities, by Rudolph Hering, the fact will be found stated that the sewage proper of Paris, France, is led in conduits to Gennevilliers below the city for purposes of irrigation, over an area of a thousand acres, and since the works were started in 1869 a village has sprung up (Gresillons) in the midst of the territory, wherein the death rate has averaged from 19.5 to 25.3. What significance, we would ask, is to be attached to this fact in an atmosphere reeking with foul odors?

RADIUS OF GYRATION.

We received a communication a few days since from an engineer of which the following is an extract:

"In using the formula for determining the strain per square inch on an iron column

Wherein R = strain per square inch
l = length of column in inches.
r^2 = square of least radius of gyration.

what method is recommended for finding the value of the least radius of gyration?"

Having had occasion during the discussion of the elevated roads proposed in a neighboring city a few years since, to compute the strength of columns, we now turned to "Rankine's Applied Mechanics" for the formula which we used on that occasion, and which we have always used in similar cases—the formula called Gordon's formula, based upon the well-known experiments of Hodgkinson and Fairbairn. Indeed at that date, specifications for bridge work called for the use of this formula. In our own experience we cannot call to mind a single instance wherein the use of a special formula for stress and strains was enjoined in drawing up specifications for bridge work, save in the computation of compression members and by this formula. We accordingly advised a correspondent in last week's issue that if r^2 in his formula was not the square of the least diameter, or the direction in which the column was most flexible, he should make it so. That is to say, for the ultimate strength of column on flat bases

$$P = \frac{fs}{1 + a\frac{l^2}{h^2}} \text{(Rankine's A. M., p. 362).}$$

A card from J. H. D., of this date, very kindly suggests that this advice given by us was doubtless given hastily, and alludes to the advantages in the use of the radius of gyration.

We are constrained to say that this was not the case, however, but that the advice was given deliberately, with a knowledge that this affectation of precision in substituting a radius of gyration in the denominator of the second term of the equation had been in use, although Rankine in his A. M. makes no mention of it whatever in this connection; but in his rules and tables the above original formula of Gordon's is transformed into

$$P = \frac{fs}{1 + \frac{l^2}{cr^2}},$$ and a table is given for the values of r^2, or the square of "radius of gyration," for the various sections of columns usually met in practice.

But Gordon's formula, in which the ratio of the length to the diameter, in the direction in which it is most flexible, is introduced, has the merit of carrying with it a principle—is simpler and more ready of use—and so far as our limited experience goes, judicious computations by means of it are as much to be relied upon as by any method which has been proposed. For in truth, the strains on a column, the resultants of the pressure upon which does not pass through the center of gravity of all of its sections (and the deviations from this axis must in most cases be very difficult of determination) cannot be determined with any precision by mere recourse to new nomenclature, and the possible errors under any system of computation must be allowed for in a factor of safety. In columns of complex angular sections there may be advantages in a recourse to the radius of gyration. We may be a little antiquated in our views of this, and if any of our readers will have the kindness to show the practical advantages growing out of the use of the radius of gyration in all cases in lieu of the diameter of least resistance to flexure in columns, with a practical illustration, we shall be extremely indebted to them, and though its practical value may be lost to us, to many of our readers not so wedded to their old ways and open to new light it may prove of incalculable advantage.

RECENT INVENTIONS.

A novel way of joining branch pipes with the water main is to provide the main pipe with an elbow-nipple opening from the side of the main and extending into the bore thereof, with an orifice of less diameter than the main. The opening in the elbow is arranged opposite the direction of the flow through the main, and in the center thereof, whereby the main current is at all times free to flow around the branch, while the orifice of the branch intercepts a column equal to its area.

A late invention relates to expansion joints for street-mains designed for steam-distributing systems for supplying cities, and it has for its object to dispense with slip-joints and large stuffing-boxes. The variations in the length of the main due to changes in temperature are compensated for by constructing the ends of the separate lengths of pipe with rigid disks or flanges, and with elastic disks bolted thereto, which permit expansion and contraction.

A new fire-annihilator apparatus contemplates holding chemicals in separate receptacles until required for use. Two inverted vessels are mounted on a frame over a common reservoir. The mouths of the vessels are closed by stoppers, which are held in place by fusible solder between them and the outer edges of the mouths. These vessels hold the chemicals necessary to the formation of a fire-annihilating gas, and do not discharge their contents into the common reservoir filled with water until the requisite temperature fuses the solder which confines the stoppers.

A novel sewer-trap consists of a spherical casing of transparent material provided with thickened threaded extensions at the points through which the two connecting pipes enter, and protect some distance into the interior of the casing. This construction admits of the connecting pipes being set vertical or horizontal, and also prevents siphonage. A light held behind the transparent globe allows of proper inspection.

A late invention in suspension bridges combines the suspension and cantilever systems; the former to carry the bridge structure, the latter the roadway and the moving load. The roadway is supported upon joints of the cantilever-stays in such manner that the links secured to the main beam communicate only an endwise thrust to the beams.

Another invention in suspension bridges has two or more cables passing over rollers on top of the piers, and under rollers fastened to the bottom of the bridge, and carrying a free weight attached to the ends of each cable. These weights and cables are to assist in carrying the bridge.

A new draw-bridge guard consists of horizontally swinging gates, secured to vertical posts which are actuated by intermeshing cogged segmental plates. These plates have slots that are engaged and operated by a pin on the bridge to move them.

Another draw-bridge guard has gates composed of two sets of vertically swinging bars, pivoted in posts at the side of the roadway. These bars are raised by a pitman pivoted to their inner ends, said pitman in turn being pivoted to a crank at one end of the rock shaft. This shaft has a corresponding crank at its other end so arranged as to be depressed by the draw-span as it closes. The bars drop by their own weight when the span is opened.

WASHINGTON, D. C. F. B. BROCK.

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ENGINEERS' SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.

Record of regular meeting, Feb. 18, 1882:

President Rudolph Hering in the chair; 34 members and 2 visitors present.

The Secretary exhibited two specimens, contributed to the Club by Mr. Chas. H. Haswell, C. E., N. Y., one being a yellow brick 1¼ in. × 3¾ in. × 6¼ in., imported from Holland early in the last century, and removed by Mr. Haswell from the premises in Broadway, N. Y., known as "Washington's Headquarters;" and the other a piece of honeycombed marble from the "Grecian," stranded on Long Island in 1870 and recovered in 1877.

He also exhibited, on behalf of Mr. Strickland Kneass, a plan of Howell's Excavator and Distributor, the object of which is the reclamation of swampy land bordering on the sea coast, by conveying material from the beach in buckets on an endless belt to a hopper, whence it is spread over the low land by scrapers on another endless belt.

He also read interesting extracts from a very full account of the construction of Market street bridge, Philadelphia, published as an addendum to the "Memoirs of the Philadelphia Society for Promoting Agriculture," vol. 1, Philadelphia, 1808. The history of the pier construction and the difficulties encountered therein is of special interest.

Mr. Charles A. Ashburner exhibited a 100-ft. contour map, recently made by him, of McKean County, Pa., in which the space between contours is shown by tints, each 500 ft. of elevation being indicated by a separate color, in five bands—shaded from light to dark as the ground descends.

Mr. Ashburner pointed out on the map the route of the Bradford Branch of the N. Y., L. E. & W. R. R., which is being built from Alton south into the coal fields of Elk County. The difficulties which have for years baffled the engineer in locating a feasible north-and-south route through McKean County were explained. The present location was made by Mr. Oliver W. Barnes. The Kinzua Creek Valley is crossed by a bridge and viaduct, being built by the Phoenixville Bridge Company. It is reported that this bridge will be 305 ft. high, will consume 40,000,000 pounds of iron, will require 30,000 yards of masonry and will cost half a million of dollars.

Mr. Wilfred Lewis stated that his attention had been called to a table of "Logarithms of all Vulgar Fractions with Numerator and Denominator not exceeding 100, arranged in Order of Magnitude," by Sir Geo. B. Airy, Hon. Memb. Inst. C. E., for the determination of teeth of wheels for a required angular speed, and that he had arranged a table with special reference to wheels in ordinary use in his own practice, by means of which the result of every single combination could be determined.

The Secretary read a communication from Mr. E. H. Kellogg, City Engineer of Denver, Col., stating that the engineers of that place were about to organize a local society.

HOWARD MURPHY,
Secretary and Treasurer.

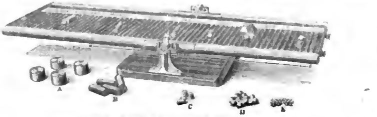
AMERICAN SOCIETY OF CIVIL ENGINEERS.

The regular monthly meeting of the Society was held at its house, 127 East Twenty-third st., New York, on Wednesday evening, March 1, Mr. T. C. Clarke in the chair.

Amendments to the Constitution relating to the Fellowship Fund were adopted.

The following candidates were elected:

As Members.—John W. Andrews, Goldsboro, N. C.; George Burnet, Jr., Indianapolis, Ind.; William H. Martin, San Francisco, Cal.; Charles H. Prior, Minneapolis, Minn.; James L. Randolph, Baltimore, Ind.

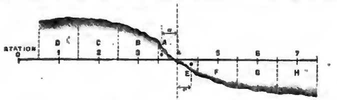


AUCHINCLOSS' AVERAGING MACHINE.

As Associate Member.—William Watson, Boston, Mass.

As Junior Member.—Cassius W. Kelly, New Haven, Ct.

The Secretary presented a copy of a bill to be introduced in Congress authorizing the appointment of a commission to test metals and other structural materials. He also gave a report of the discussion on that subject, which occurred at the recent meeting of the American Institute of Mining Engineers, in which officers and members of this Society took part by invitation.



PROBLEM IN AVERAGE HAUL.

The following resolutions were adopted:

Resolved, That in the death of Alexander Lyman Holley, formerly Vice-President of the American Society of Civil Engineers, the engineering profession at large, no less than our own Society, has suffered a grievous loss. In him were combined not only the inventive genius to discover and successfully apply new methods of subduing the forces of nature for the benefit of mankind (as evinced in the great industries which have been developed under his direction), but a rare literary facility for arranging and distributing stores of information obtained through patient study of the works of others. By the example of his life, in his gentleness, his industry, his modesty, his deferential consideration of opposing counsels, combined with integrity, indomitable energy and power of work, the standard of our profession has been materially advanced, and a spirit of good-fellowship engendered, which has had the effect to weld in harmonious continuity of interest the several branches of a profession destined to play an increasingly important part in the advancement of civilization.

Resolved, That a committee of five be appointed to act in conjunction with similar committees which have been or may be appointed by the American Institute of Mining Engineers and the American Society of Mechanical Engineers in any further measures that may be deemed advisable in honor of the memory of our departed brother.

Resolved, That we offer to the family of the deceased the assurance of our earnest and respectful sympathy in their affliction.

Resolved, That the Secretary be instructed to transmit copies of the above resolutions to the family, to the Secretary of the American Institute of Mining Engineers and to the Secretary of the American Society of Mechanical Engineers.

A paper upon the Averaging Machine, in its wider range and greater capacity, was read by Mr. Wm. S. Auchincloss, member A. S. C. E., its inventor. Reference was made to the machine described in a former paper (Transactions, vol. x., p. 135). That has now been remodeled, and is presented in a more compact shape. The ingenious method by which the weight of the platform is eliminated from the result of the work of the machine was exhibited and explained. This is accomplished by counterweights sliding automatically in tubes, so that in any position the unloaded platform is always in equilibrium.

Any combination of representative weights can then be placed on this platform at the proper points of the scale. By then drawing the platform to its balancing point, the location of the center of gravity will at once be indicated on the scale by the pointer over the central trunnion.

The weights may be arranged on a decimal system, with intermediate weights for closer working; or they may be made so as to express multiples or factors.

Each machine is provided with a number of differing scales, divided suitably for various purposes. When the problem is one of time, the scale represents months and days; for problems of proportion the zero of the scale is at the center of ite length; for problems for the location of center of gravity of a system from a fixed point, the zero is at one extremity of the scale, etc., etc.

The machine exhibited has 63 transverse grooves, which, by arrangement of weights, can be really made to serve the purposes of 252 grooves.

The machine is 29 in. in length, 9 in. in width and weighs 13 lbs.

With the machine can be found average dates, as for instance of purchases and of payments extending over irregular periods; also average prices, as for "futures" in common use among cotton brokers.

The problems of average haul, so often presented to the engineer, can be solved with ease and great celerity. Practical examples of the solution of other problems involving proportions or averages were given by the author.

THE COLORADO INSTITUTE OF ENGINEERS.

LEADVILLE, Col., Feb. 15, 1882.

Resolved, That to the scientific and technical papers in the United States, and to all papers in Colorado, the following notice be transmitted for publication, in order to make known the existence and objects of the Colorado Institute of Engineers, and to invite the co-operation of other scientific associations, journals and those interested in scientific investigations and industries.

NOTICE.

The Colorado Institute of Engineers has been organized by the civil, mining and mechanical engineers, chemists and metallurgists of the city of Leadville, Col., for the purpose of affording an exchange of scientific ideas; the professional improvement of its members; the advancement of mining industries; the fostering and encouragement of scientific research in the many fields which this country affords; the establishment of a library and reading-room, of technical works, periodicals, communications and original manuscripts; the collection of a mineral cabinet, and the creation of a central point of reference and union for its members.

Much care has been employed to make the initiatory steps in the formation result in the proper basis for a permanent and reliable association.

The encouragement which has been given warrants us in saying that we believe the success of the undertaking to be fully assured.

The organization was completed on Jan. 25, '82, and rooms secured for the Institute in the post-office building at Leadville, Col.

The regular meetings are held at the Institute rooms on the last Wednesday of each month.

All persons interested, visiting the city, are cordially invited to use the rooms of the Institute during their sojourn here.

Any further information desired can be obtained by addressing the Secretary.

THOS. W. JAYCOX, President.
FRANK L. SIZER, Secretary.
P. O. Box 248.

ENGINEERING CLUB OF RIO DE JANEIRO.

From the *Rio News*, of Rio de Janeiro, Brazil, we clip the following item:

The Engineering Club of this city has undertaken the organization of an annual congress of representatives from all the railways of the empire, to be held in the month of June. The plan includes delegates from the companies, administrations and fiscalization departments; also national and foreign engineers who wish to attend, and a commission appointed by the Engineering Club. The congress will be in session for one month, which will be divided into four sessions: 1, organization and choice of subjects for discussion; 2 and 3, discussion of these subjects; 4, reading or presentation of any works which the delegates and engineers may wish to bring before the congress, for which the first session made no provision. The club proposes to bear the expenses of the first congress and publish its minutes and other labors.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 67.

CCXX.—MORRISTOWN.

Morristown, New Jersey, in lat. 40° 48' N., long. 74° 28' W., on the Whippany River, a small tributary of the Passaic, is in a hilly district and is situated chiefly on a sandy promontory with steep slopes.

Settled in 1725, it was incorporated in 1865. Water-works were built in 1799 by a private corporation. The name of the designer of the works is not known. The water was taken from springs rising in the valleys of the gravel hills west of the town and collected in impounding reservoirs formed by dams of earth. Three reservoirs have been built from time to time, the last in 1880 under the direction of George W. Howell, C. E. This is the largest and holds 16,000,000 gallons. The others hold respectively 1,400,000 and 2,000,000 gallons.

Two 6-in. pipes, one of cast iron, the other of wrought iron and cement, conduct the water from the storage basins to a stone reservoir 70 by 200 ft. and 14 ft. deep, on ground 70 ft. above the level of the greater part of the city. In times of drought it is necessary to take a part of the supply from the river, by pumping with a Worthington steam pump erected in 1865.

In drawing from the storage reservoirs, the water is taken from near the surface and dropped through fine wire screens, to bring all the water in contact with the air.

Distribution is by 13 miles of cast-iron pipes, of from 6-in. to 3-in. diameter, with 70 fire hydrants and 600 taps. For hydrants the city pays $17 each per year; 60 meters are in use. Some wrought-iron and cement pipe were used at one time, but did not give satisfaction. Service pipes are of lead, of galvanized iron and of cast iron 2 in. in diameter. The last named are preferred.

The population in 1880 was 5,446, and the daily consumption about 200,000 gallons in the times of greatest use.

The capital stock of the company is $50,000. The cost of the works has been $188,000, including certain lands and water rights not yet utilized. There is a bonded debt of $50,000 at 6 per cent. interest. For many years prior to 1869 the stock was held by one person, and no records were kept. In 1881 the expenditures for all purposes were $8,800 and the receipts $15,000.

Henry C. Pitney is President, and Edward Pierson Secretary and Treasurer of the company.

CCXXI.—SIDNEY.

Sidney, Ohio, in lat. 40° 27' N., long. 85° 18' W., on the Great Miami River, is on a level plateau surrounded by hills. The surrounding country is rolling. Settled in 1820, it was incorporated as a city in 1850. Water-works were built in 1873 by the city, after plans of T. R. Scowden, C. E., taking the supply from Mosquito Creek, a small stream receiving the drainage of a considerable area of marshy and springy ground. A small stone dam across the creek diverts the water into a raceway 2 miles long, which conveys it to a point where 29 ft. head is obtained, which furnishes power for driving Holly pumps, which deliver into the mains. A reservoir of 2 acres area supplies the pumps. The highest part of the city is 50 ft. above the reservoir. The ordinary pressure maintained at the pumps is stated to be 100 lbs. and the fire pressure 170 lbs. Five miles of cast-iron mains of 12-in. to 4-in. size, with 40 fire hydrants and 150 taps are in use. Lead and wrought-iron service pipes are used.

The population in 1880 was 4,250, and the daily consumption about 8,000 gallons.[*]

The works have cost $54,000. The cost was met by bonds bearing 6 per cent. interest, the interest and part of the principal payable annually in such proportion as to extinguish the debt in 20 years.

The expenses of maintenance in 1881 were $300, besides an annual rental of $800. The receipts were $560.

The name of the superintendent is not furnished.

CCXXII.—ST. ALBANS.

St. Albans, Vermont, in lat. 45° 47' N., long. 73° 9' W., is on a small stream emptying into Lake Champlain. It was incorporated as a village in 1859. Water-works were built by the village in 1873, after the plans of John T. Fanning, C. E., taking water from the stream.

A dam 400 ft. long and 28 ft. high, of earth, and 20 ft. wide on top, with inner slope of 2½ to 1, and outer of 1½ to 1, and an embankment of 1,950 ft. long across low ground, create an impounding reservoir of 28 acres area, and holding 100,000,000 gallons, stowing the drainage of about 3 square miles. The reservoir is 336 ft. above the town.

Distribution is by 14 miles of wrought-iron and cement pipe with 54 fire hydrants, 37 gates and 500 taps. Five meters are in use. Service pipes are of galvanized iron. The head is so great that it is necessary to use a regulator on the mains. The population in 1880 was 7,201 and the daily consumption 600,000 gallons.

The works have cost $165,000, and the total receipts have been $46,000. The bonded debt is $156,000. The expenses in 1880 were $1,362.61 and the receipts $6,359.78. The works are managed by a board of five trustees; Marshall Mason is the Superintendent.

CCXXIII.—LOGANSPORT.

Logansport, Indiana, in lat. 40° 45' N., long. 86° 22' W., is on the Wabash River at the mouth of Eel River. The business part of the town is between the rivers and 40 ft. above them. Two miles back from the river the ground rises to a height of 200 ft.

Settled in 1828 it was incorporated as a city in 1838. Water-works were built by the city in 1876 after the plans and under the superintendence of Walter A. Osmer, C. E., taking the supply from Eel River, which in its course of 100 miles receives the drainage of a territory about 30 miles wide.

A dam of timber across the stream at the city gives a head used to drive a water wheel operating 4 Cope & Maxwell piston pumps, of 11-in. bore and 24-in. stroke, pumping directly into the mains. Auxiliary steam power is provided, but seldom used. The ordinary pressure maintained is 45 lbs., and the fire pressure 80 lbs. Distribution is by 9½ miles of cast-iron pipe, with 89 fire hydrants, 154 gates and 400 taps. Lead service pipes are used. There are 6 meters in use. The population in 1880 was 11,198, and the daily consumption 500,000 gallons.

The works have cost $182,000. The bonded debt is reported at $172,000, bearing 6 per cent. interest. The expenses of maintenance in 1881 were $3,000, and the receipts $6,900.

The works are managed by a board of three trustees, appointed by the City Council. Robert Johns was Superintendent and Engineer from 1876 to 1878, and William H. Schrier from 1878 to 1882. Terrence McGovern is Clerk to the Board.

CCXXIV.—ST. JOHNSBURY.

St. Johnsbury, Vermont, in lat. 42° N., long. 71° W., is in a hilly region, on the Passumpsic River.

Settled in 1787 it was incorporated as a village in 1852. Water-works were built by the village in 1876, after the plans of J. P. Flanders, taking the supply from the Passumpsic River, a timber dam across which worked a water power used to drive a Flanders pump delivering directly into the mains, with an ordinary pressure of 80 to 100 lbs. and a fire pressure of 100 to 125 lbs. per square inch.

The water is delivered to the pumps by passing up through 4 ft. of gravel. This filter is reported to give satisfaction. Distribution is by 8 miles of cast-iron pipe of 12 to 4-in. diameter, with 77 fire hydrants, 27 gates and 306 taps. Service pipes are of wrought iron.

The population in 1880 was 5,806, and the daily consumption 250,000 gallons.

The works have cost $80,000. The bonded debt is $75,000. Further financial statements are not given. The works are managed by a board of five trustees. John N. Gale is the Superintendent.

CCXXV.—LOGAN CITY.

Logan City, Utah, in lat. 41° 43' N., long 112° W., is on the Logan River, which has a watershed of 150 square miles in the Wachusett Mountains. The town is on three plateaux, rising from the river, and is near the base of the mountains, which rise from 7,000 to 12,000 ft.

Settled in 1859, it was incorporated as a city in 1866.

Water-works were built by the city in 1878, after the plans and under the superintendence of James H. Martineau, C. E., taking the supply from the river 2½ miles above the town. An open canal, 20 ft. wide on bottom, and used for irrigating purposes also, conveys the water 1¾ miles. That used in the city is drawn then into a settling basin, in which the sand held in suspension is deposited. From this the water is carried 1,100 ft. in a conduit 12 by 16 in., of 2-in. pine plank, laid 5 ft. below ground, and also through a section of stone conduit laid in cement, to another settling basin. From this it is conveyed in pipes for 1,300 ft. to a reservoir 20 by 65 ft. and 12 ft. deep in 6 compartments, built in excavation, with stone walls 2 ft. thick laid in cement and with concrete bottom. The water passes through three compartments on either side of a central wall, with screens between them. Either side can be cleaned and drained while the other is in use. The reservoir is 103 ft. above the main part of the city and 130 ft. above the lower part. Distribution is by 1 mile of cast-iron pipe of 10-in. to 4-in. diameter, and 1 mile of 4-in. wooden pipe, bored out of solid Oregon pine, banded with iron and coated with coal tar. It is made in 8 ft. lengths. There are 13 fire hydrants, 2 gates and 11 taps. Service pipes are of galvanized iron.

The population in 1880 was 2,878 and the daily consumption 5,000 gallons.

The works cost $13,000. There is no debt.

The expenses of maintenance in 1880 were $100 and the receipts $900.

The works are managed by the City Council, with a superintendent, James Adams.

CCXXVI.—KENOSHA.

Kenosha, Wisconsin, in lat. 42° N., long. 88° W., is on the shore of Lake Michigan. The bank is from 8 to 15 ft. above the lake, and rises gradually for three miles westwardly to the divide between the Mississippi River and the lakes, 60 ft. above the lake.

Settled in 1835, it was incorporated as a city in 1850. Water-works were built in 1879 by a private company, after plans of Charles O'Connor, taking the supply from an artesian well of 4½-in. bore and 1,365 ft. deep. Rock was encountered at 90 ft. below the surface. The well is tubed with iron pipe for 185 ft. from the surface, and the pipe discharges directly into the mains, which are of cast iron of 6-in. to 3-in. diameter; 5½ miles are in use, with 27 fire hydrants, 12 gates and 380 taps. The city pays $33⅓ per year for each hydrant. Service pipes have been used of lead, galvanized iron and plain wrought iron. The last is rapidly destroyed by the water. The temperature of the water is 60° F. The free discharge of the well is estimated at 1,300,000 gallons per day. The head on the mains is ordinarily 20 to 30 lbs., and fire pressure 30 to 40 lbs. The population in 1880 was 5,048. The daily consumption is estimated at 400,000 gallons.

The capital stock of the Park City Water Company is $17,500. The works have cost $25,000, and the receipts have been about $6,000. There is no debt. The cost of maintenance is $800, and the receipts for 1881 were $8,100.

E. G. Hazelton is the Superintendent and the Business Manager.

CCXXVII.—STATE CENTRE, IOWA.

State Centre, Iowa, in lat. 42° N., long. 93° 4' W., is on level ground on the plateau forming the divide between the Iowa and Skunk rivers.

Settled in 1859, it was incorporated as a city in 1869. Water-works were built in 1879 for the city, by the Batavia Wind Engine and Pump Company, taking the supply from two wells 58 ft. deep, and pumping by three deep-well pumps of 8-in. bore and 10½-in. stroke, operated by two windmills, into a wooden tank 18 ft. high, holding 80,000 gallons, and set on a frame 30 ft. above ground.

Distribution is by 1 mile of 6-in. cast-iron pipe, with 10 fire hydrants and 11 taps. Iron service pipes are used.

The population, in 1880, was 1,000. The consumption is not known.

The works cost $10,000. There is a bonded debt of $7,000, at 7 per cent. interest. The expenses in 1881 were $150, and the receipts $100.

The works are managed by a board of water commissioners. J. O. Cutler is the Superintendent.

[TO BE CONTINUED.]

The receipt of statistics, as follows, is acknowledged with thanks: From James H. Martineau, city engineer, statistics of water-works of Logan City, Utah. From R. H. Elam, superintendent, statistics of water-works of Pioche, Nev. From D. Allen, secretary, statistics and rates of water-works of Salem, Or. From Walter A. Osmer, city engineer, statistics of water-works of Logansport, Ind. From O. Z. Hamel, superintendent, statistics and rates of water-works of Three Rivers, Canada. From John C. Knowlton, water commissioner, statistics and rates of water-works of Watertown, N. Y. From P. L. Merritt, agent, statistics of water-works of Mission San Jose, Cal. From E. G. Hazleton, superintendent Park City Water Co., statistics and water rates of water-works of Kenosha, Wis. From the superintendent (who declines to give his name), statistics of water-works of Sidney, O. From J. O. Cutler, superintendent, statistics of water-works of State Centre, Ia. From George W. Howell, C. E., statistics of water-works of Salamanca, N. Y., and Warren, Pa. From John N. Gale, superintendent, statistics, water rates and annual report for 1881 of water-works of St. Johnsbury, Vt. From Eli W. Gilbert, secretary and acting superintendent, statistics of the water-works of Bethel, Conn. From Addison Lane, superintendent, statistics and water rates of the water-works of Melrose, Mass., and reports for 1869 to 1871 and for 1881. From George F. Bliss, superintendent, statistics of the water-works of Eureka, Nev.

CORRECTIONS.—Feb. 18, 1882, p. 58, *Hingham*, 7th line, for *reserving* read receiving. *Waverley*, 12th line, for *center* read *centre*; 14th line, for *breast wall* read *heart wall*. Feb. 25, p. 67, *Hannibal*, 4th line, for *by a private company* read *for a private company, by Carroll E. Gray.* 24th line, for 150,000,000 *gallons* read 1,500,000 *gallons*. 3d line from end, for 7 *per cent.*, read 8 *per cent.* Feb. 4, p. 39, *Greenfield, Mass.* A. A. Rankin writes that the capacity of the reservoir is 18,000,000 gallons, instead of 10,000,000 gallons, as he first reported. There are no water-works in the following towns, included in list of Jan. 28, taken from previous lists:

Ann Arbor, Mich.
Dixon, Ill.
Houlton, Maine
Worcester, Vt.
Milford, Conn.
Reading, Mass.
East London, Canada.
Beloit, Wis.

There are no towns, and consequently no water-works, of the following names in the States to which they are credited in the list of Jan. 28. The names were taken from newspaper items:

Greenville, Mass.
Lagona, Ohio.
Crawfordsville, Pa.
Susquehanna, N. Y.

To the list of water-works, add

Warren, Pa.
Salamanca, N. Y.

THE NATIVE PERSONNEL OF JAPANESE RAILWAYS.

The skill and ingenuity of the natives of Japan have long been well known, and another proof of their possession of these qualities is given by the aptitude which they display in learning the working of railways and qualifying themselves to fill the more responsible of the subordinate positions. The Japanese, from whom, for some time past, all the stationmasters and porters, as well as platelayers and artisans, had been drawn, have latterly been gradually replacing the English engine-drivers, and apparently with satisfactory results. The chief fault to be found with the native drivers is seemingly that they do not thoroughly understand the construction of the engines under their charge, but this is a matter which longer experience will rectify. There also appears to be a lack of presence of mind and watchfulness, and it is somewhat ludicrous to read of a driver starting with only half of his train in broad daylight, and not discovering the want of the other half until he had reached the next station. It is, therefore, not surprising that strict examination and supervision has to be kept on all engines under native drivers, in order to avoid any chance of failures or casualties. At the same time, we are assured that very few mishaps had occurred—indeed, so far as misadventures with the locomotives are concerned, the Englishmen appear to have been quite as often at fault as their native fellows—whilst the increasing number of Japanese employed bears testimony to the confidence which is felt in their capabilities. In other capacities the native workmen display great skill, the carriage and wagon building, for instance, being carried on in a highly satisfactory manner by the Japanese foreman carpenter; and two engines, which had been transferred from one line to another, having been put together again and got ready for work by a native fitter without any assistance from Europeans. The only complaint made against them is that they are somewhat slow. It is clear, however, that the Japanese are quite well enough qualified to carry on the working of their railways; and, after the system has been completed, we should not be surprised to find that eventually they took the entire control into their own hands.—*London Architect.*

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[*] The superintendent reports 200 barrels. This is extraordinarily small.

CORRESPONDENCE.

ADJUSTMENT OF GRADES TO CURVES.

Continued from Page 71.

Vose, professor of civil engineering in Bowdoin College, in his "Manual for Railroad Engineers."

EQUIVALENT GRADE CURVE IN FEET PER 100 FEET.

	Scheffler.	Vose.	McClellan.
1°	0.044	0.045	0.03
2°	0.087	0.091	0.06
3°	0.131	0.136	0.12
4°	0.174	0.181	0.17
5°	0.218	0.227	0.22
6°	0.262	0.272	0.28
7°	0.305	0.318	0.33
8°	0.340	0.367	0.40
9°	0.392	0.409	0.47
10°	0435	0.458	0.54

Up to 7° the results agree pretty well with each other, but from hence the difference between second and third columns and fourth is growing rapidly, so that 18° gives:

Scheffler.	Vose.	McClellan.
0.78	0.858	1.54

As it is a fact that the resistance don't increase directly as the curvature, Mr. McClellan's formula is probably the most reliable, and it will be very interesting to learn his further experiments to test the correctness of his formula.

H. K. GLAHN, C. E.

CENTER OF GYRATION.

EDITOR ENGINEERING NEWS:

If when you consulted that "wiseacre" Rankine in answering your correspondent's query on this subject in your last issue, you had turned to page 515 of the work cited (Applied Mechanics), you would have been able to have better satisfied said correspondent's very laudable desire for knowledge, and perhaps have added somewhat to your own stock in trade.

Rankine there defines "radius of gyration" as "that length whose square is the *mean of all the squares* of the distances of the indefinitely small equal particles of the body from the axis, and is found by dividing the moment of inertia by the weight." Your correspondent may understand this better if you tell him that this means that distance at which if the entire weight is supposed concentrated in a single point, that point must be from the axis, *in order that the moment of inertia may be unchanged.*

It might be also well to call his attention to the fact that it is *only* with reference to rectangular and cylindrical cross-sections that we have $\frac{l^2}{h^2}$ — where h is the *least diameter.*

If you had looked along a little further to page 364, you would have found that for *other* cross-sections we must substitute *for* h^2 r^2, that is, the square of the least radius of gyration.

May I ask in my turn what is a "wiseacre?" One whose knowledge exceeds one's own, or one who thinks what he doesn't know isn't worth knowing? *

[Came before EDITOR too late for answer.]

STADIA SURVEYING.

SANDUSKY, O., Feb. 23, 1882.

EDITOR ENGINEERING NEWS:

In the fifth number of volume 9 of your excellent paper is an interesting article by U. S. Assistant Engineer James P. Allen, on "Stadia Surveying." I believe that, outside of the U. S. Engineer Corps, very few surveyors have used this method, and the profession know but little about it, and hence do not properly appreciate its excellence. Having had occasion to survey a large body of coallands where it was next to impossible to get anything like accurate chaining done, I resorted to the stadia plan. I have a Troughton & Simms theodolite with adjustable stadia wires placed horizontally, which, *with proper care*, gives excellent results.

As I believe in simplifying all my calculations, I have endeavored to carry this principle into the stadia method of measuring. In 1868 Mr. B. S. Lyman demonstrated that the proper place to commence counting was from a point as far in front of the objective glass as the focal length of that lens. In my instrument this distance, from the center of the instrument, is 1.25 ft., which is generally used as a constant to be added to each observed distance. This is but a small matter; but it is just as well to get rid of it. I avoid this difficulty in a very simple manner. I use a nicely divided leveling rod with two targets; the lower one, instead of reading zero, is fixed when observing for distance, at 0.0125. Then, while the lower wire is on this target, the upper target is moved to the precise places cut by the upper wire. So that I get at once the precise distance from the center of the instrument to the observed station.

To adjust the wires, I measure accurately between two pegs—say 300 ft. I set my instrument 1.25 ft. back of the starting point, and set my lower target at 4.5 ft. and the upper at 6 ft. Then I use my center wire, and each of the movable wires is adjusted so as to read precisely 1.5 ft. from the center line. Then set the lower target at 3 ft., leaving the upper one at 6 ft.; and the stadia wires must cut the centers of the targets.

Another matter, which I do not see noticed in any work except Nickell & Strassberger's catalogue, viz., that, in reading the rod, for distance, it should be held at right angles with the line of sight. In the English plan this is accomplished by holding the stadia rod in a horizontal position, while the wires are vertical. I have my rod-man carry a square, with small sights, which he applies to the rod, and leans the rod back or forward so that the line of the sights on the square will strike the telescope. Perhaps this is understood by engineers generally; but as it may not be by some of the young members, I thought it best to call attention to it.

Of course to get the vertical angle, the vertical height of the center of the glass above the nail at the station is measured: and then the rod is held plumb at each nail, with the target at the height of instrument, and the vertical angle measured while in that position. Indeed, that is the first thing I do before moving the target for distance.

I place my stations at every change of surface, and number them from O to the end of each line, and sight first for vertical angle, and then for distance at each station as far as I can get distinct vision. I then move forward to the last station (or to such station as may prove to be a proper turning point), measure height of instrument, have a stadia rod held at my last turning point, and test for vertical angle and distance. Then I go ahead again as far as I can see clearly.

My horizontal limb is divided to 360°. And I keep the body parallel to either the magnetic or an assumed meridian, and, of course, can lay off any other line or lines in any direction from the instrument, and in this way get the contour lines very nicely.

In reducing my work I do not trust to any graphical construction. I use the best tables of cosines and sines, and reduce every observation in that way. The graphical plan may do for intermediates, but I certainly would not trust it for turning points.

If these hurried statements will be of service to any of our younger brothers, make such use of them as you think proper.

GEORGE MORTON, C. E.

THE STANDARD METRIC CHAIN.

BOSTON, Feb. 15, 1882.

EDITOR ENGINEERING NEWS:

In a previous communication the writer endeavored to show that the *double-dekameter*, or twenty-meter measure, is eminently adapted to be used in extensive engineering operations from the fact that, in its total length, it is one of the standard series of metric linear measures, and that, in common with every measure of that series, it possesses the valuable property that every smaller metric unit is an aliquot part of it, while it is itself an aliquot part of every larger metric unit.

The *double-dekameter* also possessed some peculiar properties which render it equally well adapted to the details of surveys. Being an assemblage of twenty units it can be divided into 2, 4, 5, 10 or 20 equal parts without requiring the use of fractions of the unit; its eighths, moreover, merely require the use of the fraction 0.5, while its hundredths are expressed in meters by the simple decimal 0.2 and its multiples.

These properties are valuable in the details of surveys where a series of equi-distant offsets are required, the distance between which shall be an aliquot part of the total length of the measure employed, as is the case where railroad curves are laid out by offsets from the chord, and in some other instances.

It is desirable that a table should be published, giving, in meters, the radii, tangent deflection, chord deflection and ordinates of curves of different degrees of curvature, corresponding to a chord of 20 meters. Until such a table shall have been published, the ordinary tables may, however, be used by a simple modification.

The ordinary tables being computed for a chord of 100 units, the various values contained in them are the values in meters corresponding to a chord of 100 meters, and they could be used in their present form were it practicable to use so long a chord.

The hundredth part of twenty meters being 0.2m., and of ten meters 0.1m., we may use the following rule:

To convert the values for the radii, tangent and chord deflections and ordinates for curves given for chords of 100 ft. into the corresponding values in meters for chords of 20 meters, multiply the tabular values by two, and move the decimal point one place to the left; to find the values in meters for a chord of ten meters, move the decimal point one place to the left.

In order to most conveniently reach the decimal subdivisions of the meter, metric surveying chains are constructed with *five* links to the meter. The French chains are made with a *brass* ring at each meter, instead of the iron rings used on the rest of the chain, and a tag is placed at every *fifth* meter. This arrangement requires a considerable length of the chain to be examined at each partial measurement, which is inconvenient. A more perfect arrangement has been recently introduced by the Messrs. Gurley, of Troy. On a twenty meter chain of their manufacture in the possession of the writer, a tag is placed at each meter. These tags are numbered from 1 to 20, continuously, from one end of the chain; the central tag, however, is larger than the others, and is marked in full, thus: "10 meters—1 dekameter." The chain is made with five links to the meter, or 100 links altogether.

This marking of the central tag is valuable both because the dekameter seems likely to be used as the unit for numbering the stations on railroad work and because it is a constant reminder, in the field, that the chain length is a double measure, and that distances are not to be given in terms of it, but rather in terms of some metric unit. To state distances in terms of a double measure is more reprehensible with metric measures than it would be with the old measures. Yet, with them, lengths are never stated in terms of the two-foot rule, but always in terms of the unit, the foot.

The practice, when applied to the 25 meter chain, as has been done in Mexico, requires that 25 shall be continually borrowed or carried after the fashion of the old British denominations.

To perpetuate these methods after the adoption of the metric measures will be to sacrifice the most important benefits that may be gained by their proper use.

In justice to the profession it should be said that the confusion now existing on the Mexican roads is largely due to the abruptness with which the metric measure was demanded. Work had to be adapted to an unfamiliar system of measures under the pressure of actual construction. Dealers in engineering supplies were unexpectedly called upon to furnish large quantities of metric measures at a day's notice. Heterogeneous outfits, confusion and disappointment, are the natural sequences of such conditions.

It is to be hoped that upon the completion of work already systematized the profession will abandon all imperfect implements and methods, and uniformly adopt those that are thoroughly based upon sound decimal principles, and are therefore able to develop the application of the metric system in all its simplicity and beauty.

The most important features are:

1. The uniform use of the double-dekameter, or 20 meter measure, in field work.
2. The use of 20 meter stations and 20 meter chords on ordinary work; numbering the stations from an initial point in terms of some one of the metric units, preferably the dekameter.
3. The exclusive use of the standard series of metric draughting scales, which embraces the scales 0.002, 0.0025, 0.003, 0.004, 0.005, 0.006, 0.008, 0.010, 0.015, and their decimal derivatives.
4. The exclusive use of profile and cross-section paper whose rulings are based upon the half centimeter, the centimeter, or the double centimeter.

Of less vital importance, but of great practical utility may be mentioned:

5. The leveling rod, on which the figures indicating units are repeated at every decimeter, forming with the other figures a continuous numbering in decimeters.
6. Ranging poles 3 meters long marked in bands 0.5 meter wide, or 2 meters long marked in bands 0.2 meter wide.

An engineer supplied with the outfit here described can execute metric work according to the most approved methods.

CHARLES M. SWAN, C. E.,
Chairman of the Committee on Manufactures of the American Metric Bureau.

ARTIFICIAL BALLAST.

NEW YORK, March 1.

EDITOR ENGINEERING NEWS:

Will some of your readers please give the method of making artificial ballast of burnt clay for railroad purposes, or a reference to some description of its use in American or European practice?

A. B. C.

DYNAMICAL.

CHICAGO, Feb. 16, 1882.

EDITOR ENGINEERING NEWS:

We would like to have you decide the following wager: There is a safe in the corner of the office. A bets he can lift that safe. B bets he cannot lift the safe. Please let us know if A be allowed any implements to lift the safe with, or has he to do it by bodily strength. Inclosed find stamp for return mail. Hoping to hear your decision, we remain, respectfully, EMPLOYES OF ——.

[It should be raised at arm's length by bodily strength only, like a dumb-bell.—ED. ENG. NEWS.]

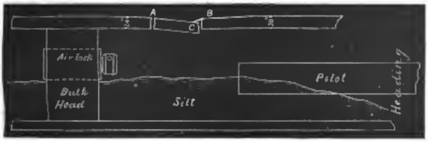
[A is entitled to use any *safe* means whereby *his* muscular exertion alone is exercised in the performance of the feat.—THE OTHER EDITOR.]

PROGRESS OF THE WORK ON THE HUDSON RIVER TUNNEL.

On Tuesday last we visited the New York terminus of the tunnel to note the progress which had been made with the caisson described in ENGINEERING NEWS of Dec. 24, 1881.

Upon entering the boarded enclosure at the foot of Morton street the first objects the eye rested upon were two large piles of brick, and the conclusion was quickly formed that the work on this side was progressing most favorably and rapidly. A closer inspection revealed the fact that these piles were only used as weights to keep the caisson down. Between them was a shaft leading down to the supply lock on top of the caisson, the material being raised and lowered by a small steam-engine located near the river side of the shaft. Descending two short flight of steps, the "passenger" air-lock was reached at the top of an iron shaft extending to the interior, means of locomotion being provided in the shape of ladders fastened to the sides. This lock is similar to the one used for some time on the other side, and with which our readers are familiar.

The inverts for the two tunnels are finished, and the sides and dividing wall completed for about 2 ft. above the interior of the bottom. In the center of the dividing wall, and at equal distances apart, are three iron pipes 1 ft. in diameter, and extending vertically from the interior of the caisson 6 ft. below the bottom of the invert. These pipes are about one-half full of broken stone, and terminate in oblong perforated boxes reaching to the masonry, and also filled with stone. The cement is mixed one to one and one to two, according to quality, while pure cement alone is used around the pipes. This cassion is sunk in a bed of sand, which extends toward the other shore for 200 or 250 ft.



LONGITUDINAL SECTION THROUGH SECOND AIR LOCK.

The problem which now perplexes those in charge is how to cut through the side and start the tunnel proper. The first experiment to be tried will be to connect the vertical pipes with powerful pumping machinery and ascertain if the water can be drawn from the side through which it is designed to cut. The opening in the caisson on the other side of the river, opposite the south tunnel, was only made after sufficient silt had been rammed through a small hole to render the outside silt of the required consistency to hold the air. But this caisson being sunk in sand, the whole aspect of affairs is changed. Moreover, it has been found that the sand will follow the water into the caisson upon the diminution of the air pressure, which on Tuesday was 26 pounds per square inch.

On the following day we visited the work at the New Jersey end, and noted several changes that had been made since the visit by the members of the American Society of Civil Engineers. Work upon the south tunnel has been stopped for the present on account of a lack of facilities for handling the material. An elevator has been placed in the shaft, and as the cars are brought up the tunnel they are run upon the platform, raised to the surface, and run upon a track leading to low lands back of the works. Walking down the north tunnel, we soon came to the bulkhead containing two air-locks, one of which was designed to be always opened toward the heading, thus affording a sure retreat for the men in case of accident. Entering this, we were soon under a pressure of about 25 lbs. to the square inch, when we emerged into the second stretch of completed work. About 300 ft. from this bulkhead is a second, which is furnished with but one air-lock. Entering this, we were subjected to a still further increase of pressure, and came out about 40 ft. from the heading. According to the mercury gauge, which we consulted after coming to the surface, the pressure in this section of the work was between 32 and 33 lbs. to the square inch.

All the material is lowered by the elevator, run down to the first set of air-locks, passed through, drawn by a horse (we may state of this animal that he stands the pressure well, eats heartily and is gaining in flesh, and that he has almost recovered from the heaves from which he suffered when first admitted) to the second lock through which it passes to the men. The entire tunnel has been kept a little over half full of excavated silt, which will be removed after the approach shall have been completed.

About 10 ft. from the interior end of the second bulkhead a break is perceived in the roof, and the 10 ft. beyond this slope rapidly downward until the far end is about 18 in. from the grade line. The 10-ft. section adjoining this is commenced on grade and so continued. The accompanying sketch will aid in understanding the work. The top of the tunnel had been finished to *A* on grade, but when the iron plates were put in place for the next section a settlement took place which resulted in a deflection at *B* of about 18 in., and left an uneven opening at *A* sufficiently large in some places to thrust in the hand. The next section, commencing at *B*, was started on grade and so finished. The opening at *B*, between the ends of the masonry, is large enough for a man to crawl into. In order to keep the silt back short boards and plates have been inserted from *B* to *C*. The section beginning at *B* has been finished, and work is now in progress on the next one. We were informed that the grade of the lower portion of the tunnel had been kept true. To strengthen the tunnel the arch is now being made 2½ ft. thick, the increase being made as shown in the drawing.

After completing the section now being built, that portion between *A* and *B* will be removed and rebuilt on the proper grade. This settling seems to have resulted from the failure of the surrounding silt to hold the air, and the two following sections were begun in order that it might have time to attain the requisite consistency. The work at the heading is carried on in the manner so frequently described.

All the work completed since the accident of 1880, from about 300 ft. from the shaft to the second air-lock, presents the appearance of excellent workmanship. The grade has been kept, with the exception of that section above described, and the interior surface is straight and regular.

The tunnel is lighted by electricity furnished by two dynamo machines located in the engine-room, the lights being so distributed as to illumine the work from the shaft to the heading.

In an undertaking of this description much depends upon the class of workmen employed, and the class in turn depends upon the wages paid. The masons get from $3.50 to $4, and the laborers and helpers from $1.50 to $2.25. At present each shift works eight hours, with a one-half hour rest outside.

Almost every man has had an attack of the "bends," although no very serious cases have as yet occurred. Strict rules have been found necessary for the good of the men. Every new man is examined for heart or lung trouble by the surgeon of the company. It is compulsory for the men when entering to use the elevator in preference to the stairs leading to the bottom of the shaft. Hot coffee is sent into the tunnel just before the time for coming out. All violent exercise is discouraged, the use of spiritous liquors prohibited, and regular habits recommended.

◆

RECENT INVENTIONS.

A novel means for transporting and delivering dredged material from the bed of shallow waters upon the river-flats is as follows: A scow or lighter provided with railway tracks, and having dumping cars thereon, is towed to a dredging machine in position for operation, and the cars are filled by the dredger. The lighter is then towed to a landing-pier, with which it is connected by means of a floating bridge provided with a railway track, and supported on another scow or lighter. The bridge is hinged at the center, on a raised support on the scow, and its outer ends are supported by weighted levers, the fulcrums of which are supported by standards at the corners of the scow. When in position the inner end of the bridge rests on the pier, and the outer end on the loaded scow. A locomotive is then taken down the pier and over the bridge and coupled to the dumping-cars, which are drawn off to the desired place and dumped, and are then returned to the lighter to be reloaded. The pier has two or more tracks of different grades of inclination extending back to a common track; and the floating bridge, with its track, is shifted laterally to connect with the several tracks, according to the state of the tide.

A new draw-bridge guard consists of vertically sliding barriers, arranged at either end of the draw-span to close the thoroughfare leading to it when the draw is open, and which, in their normal positions, are raised above the tops of passing vehicles. Counterweights, running over pulleys, are employed which are heavier than the barriers. Auxiliary weights are so arranged as to slide the barriers in a position to block the highway when the draw is open, and which, at any time, can be tripped by the swinging bridge, or independently thereof, regardless of the position of the span, to allow the barrier to rise. These auxiliary weights, when brought into service, give the barriers the balance of power, and thus overcome the counterweight, causing the barriers to descend. The upward and downward movements are initiated by the swinging bridge.

The following invention is designed to protect bridge-piers, docks, etc., from the lodgement of floating drift matter, by a vertically-moving wheel or cylinder, having a barbed outer surface. This wheel is located (up stream) in front of the pier, or object to be shielded. The force of the current causes the floating object to rotate the wheel, thereby deflecting it and causing it to pass on. Means for rotating the wheel by hand are provided when desired.

A late foreign invention patented in England by a Frenchman, has for its object to produce an instrument for use by surveyors, architects, builders, etc., either as a spirit level or as a pencil. For this purpose a tube, preferably circular or elliptic in cross section, is used, into which a pencil and pencil-case with movable lead is introduced. This tube has on the upper side one or two openings closed with glass, and it is filled with suitable liquid having a bubble of air for observation through the openings. The pencil-case passes into or through the liquid, or the tube may have a lateral recess for the pencil-case. The liquid receptacle may be made of glass or crystal, and surrounded with a metallic sleeve which forms the pencil-case. Provision is made providing the tube with a scale to denote inches, centimeters, etc.

A novel excavator has a series of rotating picks which loosen the earth to be excavated. These picks are arranged upon endless traveling chains, which pass over suitable forward and rear pulleys supported upon a wheeled frame. A series of rotating shovel-buckets are also secured to the endless chains, which take up the loosened earth and elevate it to the desired point. Swinging bottoms to the buckets accommodate the action of a cleaning scraper.

Another late invention in excavators consists of a wheel having a series of radially and circumferentially arranged buckets of the following construction: The vertical cutting edges of the sides of the bucket convey from the top toward the cutting edge of the bottom, presenting with said bottom edge an outline similar to a truncated wedge; and the edges, as they extend rearward toward the upwardly curved bottom, converge rearward. The effect of this construction is that in excavating the cutting edges cut a ditch of greater depth and width than the body of the bucket, this giving the bucket free and easy clearance in the ditch, while the enlargement of the bucket toward the top gives the earth free clearance therefrom as the bucket is revolved. The bottom of the bucket is extended above the sides, in the form of a mold-board of a plow, to throw the earth out laterally.

WASHINGTON, D. C. F. B. BROCK.

◆

RELATIVE NON-CONDUCTIVITY.

Mr. Charles E. Emery, of this city, recently made some experiments upon relative non-conductivity, with reference to the needs of the New York Steam Company. His apparatus consisted of a boiler 12 ft. long and 4 ft. in diameter, with three 10-in. flues passing through it. Inside these flues were smaller tubes, through which the steam passed. The non-conductors surrounded the inner tubes, and water was kept circulating around the flues in the outer shell. A layer of hair felt 2 in. thick gave the best result, and, using equal thicknesses of the other materials, the following results were obtained:

Material.	Non-conductivity. Per cent.
Hair felt	100
Mineral wool, No. 2	83.2
Mineral wool, No. 2 and tar	71.5
Sawdust	68
Mineral wool, No. 1	67.6
Charcoal	63.2
Pine wood, across grain	55.3
Loam	55
Gas works lime, slaked	48
Asbestos	36.3
Coal ashes	34.5
Fuel coke	27.7
Air space, 2 inches deep	13.6

The low result from air space no doubt is due to the unimpeded circulation of the currents.

CORRESPONDENCE.

SPIRAL CURVES.

T. I. O. R. R., Jaltipan, Mexico,
Jan. 18, 1882.

Editor Engineering News:

The following communication about "spiral curves" for the easing of circular curves at the points of tangent, and laid out with the transit by the ordinary method, might be interesting.

In the accompanying figure let *AO* and *OA'* be two located tangents with angle of intersection *I*. Suppose *BLL'B'* a circular curve with radius *R* located to fit these tangents, so as to have the tangent points at *B* and *B'*.

For the easing of this circular curve at the tangent points, it is required to begin at a point *A* on the tangent, at a certain distance back of tangent point *B*, and lay out a curve which shall commence at *A* with a radius of curvature equal to infinity, and as we proceed towards *B* the radius of curvature gradually to diminish until it equals that of the circular curve *BLL'B'*.

The deflection angle per unit length of chord to such a curve will be zero at *A*, and gradually increase to the end of the curve, where it will be equal to that of the circular curve *BLL'B'*.

Let the length of the easement curve or spiral be *l*, and let it be divided into any number of convenient stations *n*, then the length of each station will be $\frac{l}{n}$.

If *a* is the deflection angle per unit chord of circular curve *BLL'B'* and *x* be the deflection angle of a chord $\frac{l}{n}$ of same curve, we have

$$\text{(I.)}\quad x = \frac{al}{n}.$$

Let *d* be a certain differential. The deflection angle between *A* and first station of spiral is assumed to be the *nth* part of *x*, then the deflection angle between first and second stations of spiral is to be greater than that between *A* and first station by the differential *d*, and the deflection angle between second and third stations is to be greater than that between first and second stations by 2*d*, and that between third and fourth greater than that between second and third by 3*d*, etc.

Following this process, the deflection angle between the last two stations of the spiral should be equal to *x*, so that the spiral and circular curves shall have the same radius of curvature at the last station of spiral where it is to join into the circular curve.

Hence we have

(II.) Deflection angle between *A* and first station $= \frac{x}{n}$.

Deflection angle between first and second stations $= \frac{x}{n} + d$.

Deflection angle between second and third stations $= \left\{\frac{x}{n} + d\right\} + 2d = \frac{x}{n} + 3d$.

Deflection angle between third and fourth stations $= \left\{\frac{x}{n} + 3d\right\} + 3d = \frac{x}{n} + 6d$.

Deflection angle between fourth and fifth stations $= \left\{\frac{x}{n} + 6d\right\} + 4d = \frac{x}{n} + 10d$.

Deflection angle between (*n*—1)*th* and *nth* stations $= \frac{x}{n} + \frac{n(n-1)d}{2}$.

By what we have said before, the last equation is to be equal to *x*, hence we have

$$\frac{x}{n} + \frac{n(n-1)}{2} d = x.$$

$$\text{(III.)}\quad \therefore d = \frac{2x}{n^2}.$$

By substituting this value of *d* in set of formulæ (II.) we have

(IV.) Deflection angle between *A* and first station $= \frac{x}{n}$.

Deflection angle between first and second stations $= \frac{x}{n} + \frac{2x}{n^2}$.

Deflection angle between second and third stations $= \frac{x}{n} + \frac{6x}{n^2}$.

Deflection angle between third and fourth stations $= \frac{x}{n} + \frac{12x}{n^2}$.

Deflection angle between fourth and fifth sections $= \frac{x}{n} + \frac{20x}{n^2}$.

Deflection angle between (*n* — 1)*th* and *nth* stations $= \frac{x}{n} + \frac{n(n-1)}{2}\,\frac{2x}{n^2} = x$.

The deflection angle from *A* to 1st station of spiral will be the first equation of set (IV.); the deflection angle from *A* to second station will be the sum of the first two equations of set (IV.), that from *A* to third station the sum of the first three equations, and the deflection angle from *A* to *mth* station will be the sum of the first *m* equations of set (IV.) These angles we shall call the total deflection angles for each station.

Hence we have total deflection angle for *mth* station

$$= \frac{mx}{n} + \tfrac{1}{3}(m-1)\,m\,(m+1)\frac{x}{n^2}$$

Substituting the value of *x* given in equation (I.) we have

(V.) Total deflection angle for station *mth*

$$= \frac{mal}{n^2}\left\{1 + \tfrac{1}{3}\left(\frac{m^2-1}{n}\right)\right\}$$

The total deflection angle of the spiral is obtained by making *m* = *n* in equation (V.), which gives us if we call this angle φ

$$\text{(VI.)}\quad \varphi = \frac{al}{n}\left\{1 + \tfrac{1}{3}\left(\frac{n^2-1}{n}\right)\right\}$$

We have now to determine at what distance back of tangent point *B* of circular curve *BLL'B'* the point *A* should be situated, so that the deflection angle, for a portion of the circular curve *BLL'B'* equal in length to that part of the spiral *mn* which lies inside the tangent point *B*, shall equal the total deflection angle of spiral.

Call the length of that portion of the spiral from *m* to *n*, *l'*.

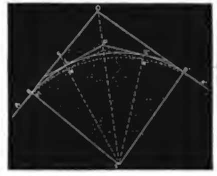
As *a* is deflection angle per unit of circular curve *BLL'B'*, the deflection angle of a portion of same curve equal in length to *l'* is *al'*; this angle has to be equal to the total deflection angle of spiral given in equation (VI.)

$$\text{Hence we have}\quad al' = \frac{al}{n}\left(1 + \tfrac{1}{3}\,\frac{n^2-1}{n}\right)$$

$$\text{(VII.)}\quad \therefore l' = \frac{l}{n}\left(1 + \tfrac{1}{3}\,\frac{n^2-1}{n}\right)$$

The distance back of tangent point *B*, where *A* should be situated is *l*—*l'*.

As in equation (VII.), *l* and *n* being constant, *l'* is also constant, we see that for a given length of spiral divided into a given number of stations, the point *A* is always at a constant distance back of the tangent point *B*, no matter what the radius of the circular curve *BLL'B'* may be; also the portion of the spiral *mn*, which lies inside tangent point *B*, is constant.



It will be noticed that, as the total deflection angle of the spiral is equal to the deflection angle of *BL* = *l'* of circular curve *BLL'B'*, and as the spiral is considerably longer, the end of the spiral will be a little inside the original circular curve *BLL'B'*.

Therefore, between the ends *n* and *n'* of spirals *An* and *A'n'*, a circular curve *nn'* has to be run in, which is concentric with circular curve *BLL'B'*.

This displacement of original circular curve *BLL'B'* is so small that the radius of circular curve *nn'*, in practice, is assumed to be equal to that of original circular curve *BLL'B'*, and run in accordingly.

This displacement is equal to *NS* — *LS*, but *NS* = length of spiral times the sine of half the total angle of deflection of spiral approximately, and *LS* equals *BL* or *Mn* or *l'* times the sine of half the angle of deflection of portion *BL* of circular curve *BLL'B'* approximately. These angles being both equal to φ, we have

Displacement or $R - R' = l - l'\ \sin.\ \varphi$,

Substituting for *l'* its value given in equation (VII.) we have

$$\text{(VIII.)}\quad R - R' = \frac{l}{n}\left(1 + \tfrac{1}{3}\,\frac{(n^2-1)}{n}\right)\sin.\ \varphi,$$

R', being the radius of circular curve *nn'*, and φ to be obtained from equation (VI.).

In practice, a length of spiral divided into any number of stations which is thought best is adopted.

When the length of spiral is adopted, it is to be unchangeable for all the circular curves used, irrespective of the radii of such circular curves.

Let us here adopt a spiral 100 ft. long divided into 10 stations. Then *l* = 100 and *n* = 10.

Formula (I.) becomes

$$\text{(IX.)}\quad x = 10a.$$

Set of formulæ (III.) become

(X.) Deflection angle between *A* and 1st station = *a*
" " " 1st and 2d stations = 1.2 *a*
" " " 2d and 3d stations = 1.6 *a*
" " " 3d and 4th stations = 2.2 *a*
" " " 4th and 5th stations = 3 *a*
" " " 5th and 6th stations = 4 *a*
" " " 6th and 7th stations = 5.2 *a*
" " " 7th and 8th stations = 6.6 *a*
" " " 8th and 9th stations = 8.2 *a*
" " " 9th and 10th stations = 10 *a*

We then have—

Total deflection angle from *A* to 1st station = *a*.
" " " *A* to 2d station = 2.2 *a*.
" " " *A* to 3d station = 3.8 *a*.
" " " *A* to 4th station = 6 *a*.
" " " *A* to 5th station = 9 *a*
" " " *A* to 6th station = 13 *a*
" " " *A* to 7th station = 18.2 *a*.
" " " *A* to 8th station = 24.8 *a*
" " " *A* to 9th station = 33 *a*.
" " " *A* to 10th station = 43 *a*

From the above we see that for a length of spiral 100 ft. and divided into 10 stations the total deflection angles of the 10 stations of spiral are given by multiplying the constants 1, 2.2, 3.8, 6, 9, 13, 18.2, 24.8, 33, and 43, by the deflection angle per foot of the original circular curve.

The constant distance back of the point of tangent of original circular curve at which the spiral is to commence is obtained from formula (VII.) which becomes

$$l' = \frac{100}{10}\left\{1 + \tfrac{1}{3}\left(\frac{100-1}{10}\right)\right\}$$

$$\text{(XII.)}\quad \therefore l' = 43\ \text{ft.}$$

And the required distance

$$l - l' = 100 - 43.$$

$$\text{(XIII.)}\quad = 57\ \text{ft.}$$

Let us now take an example with our adopted spiral.

Suppose two tangents to have an angle of intersection of 40° and that a 4° curve with 100 ft. spirals is to be located between them.

If the P. C. of this 4° curve, without spirals, was to have been at station 20 + 57, the P. T. of same curve without spirals would be at station 30 + 57.

To run in this 4° curve with the spirals, we have to commence the first spiral at a point on the tangent 57 ft. back of the original P. C., or at station 20. The end of the first spiral will of course be at station 21. The value of *a* for a 40° curve is 2.4 minutes per foot, hence deflection angle of spiral is (43) (2.4) minutes = 1° 43', and as there are to be 2 spirals the deflection angle of the circular curve to be run in between the two spirals will be (40° — 3° 26) = 36° 24 = 2,194 minutes.

The length of the circular curve to be run in between the two spirals is $\frac{2{,}194}{2.4}$ = 914 ft.

As the end of the first spiral or beginning of circular curve is to be at station 21, the end of the circular curve or beginning of second spiral will be at station 30 + 14, and end of second spiral will of course be at station 31 + 14.

Set up the transit at station 20, and for each 10 ft. station of first spiral deflect from the tangent half the angles given, by substituting in set of equations (XI.) 2.4 minutes for *a*; these angles are 1 minute, 2½ minutes, 4½ minutes, 7 minutes, 11 minutes, 15½ minutes, 22 minutes, 29½ minutes, 39½ minutes and 51½ minutes.

Having laid out the end of the first spiral, which falls on station 21, by deflecting from the tangent 51½ minutes as above, set up the transit at station 21, take a back sight on station 20 with 51½ minutes on the other vernier, turn vernier to zero, when the line of collimation will be a tangent both to spiral and circular curve to be laid out. Lay out circular curve from this tangent in the usual way, using 2.4 minutes deflection per foot until station 30 + 14 is reached, when from the tangent at this point lay out the second spiral, by deflecting the same angles used in laying out the first spiral.

Having reached the end of second spiral and having taken a back sight on the beginning of same spiral, it will be seen that the tangent is struck to a nicety. The difference between the radii of original circular curve, as run in between the two spirals, or the displacement of original circular curve, is given by formula (VIII.), which becomes in this case

$$R - R' = \frac{100}{10}\left\{1 + \tfrac{1}{3}\left[\frac{100-1}{10}\right]\right\}\sin.\ 51\tfrac{1}{2}'.$$

$$\therefore R - R' = 0.64\ \text{ft.}$$

It is readily seen that no practical error has been made in using a radius of 1,432.69 ft., instead of one of 1,432.05 ft., for the laying out of the circular curve between the two spirals.

The only objection to this method of setting out these easement curves is the short back sight, after laying out each spiral.

On this road 30 meter spirals are being laid out by locating parties as well as for track centers, and the 30 meters back sight has been found to be of no inconvenience whatever, having laid out long tangents, with this back sight, with extreme accuracy.

W. H. FRY.

NEW GEOLOGICAL DEVELOPMENTS.

FOSSIL STATION, Oregon Short Line Railway,
Via Granger, Wyoming Territory,
Feb. 20, 1882.

EDITOR ENGINEERING NEWS:

SIR: At the place we are now there are immense deposits of coal. The tunnel on the line passes through a vein 30 feet thick, and as yet but little is known by boring or shafts. The coal is now coking, but of a bright luster, and decrepitates on heat being applied or by exposure. This pass is 7,200 ft. above sea level, and is known as Hodges' Pass, after the first engineer who ran a line here. The range is the Wahsatch, and here are the most remarkable deposits of fish, oyster shells, cocoanuts, palm leaves and the mixed vegetation of different climates. No careful investigation has yet been made, and great discoveries may be made of remains of past seas. Fish are found here in the strata, perfect remains of different sizes, from 2 in. to 22 in. long. I would like you to have some of these specimens.

Yours truly, JAMES M. HAMILTON.

DANGERS OF SEWAGE AIR.

PHILADELPHIA, March 5, 1882.

EDITOR ENGINEERING NEWS:

On page 73 in your last issue, in referring to the sewage farm near Paris, in the midst of which a village has recently sprung up, you say: What significance is to be attached to this fact in an atmosphere reeking with foul odors?

As some of your readers may be misled by this question, as to true facts, I would like to state that the atmosphere in the village does not at all reek with foul odors. In fact, when driving over the fields themselves, strong odors are rarely noticed. A well managed sewage farm that has been properly laid out is not such a great nuisance as might be supposed. Only when carelessly managed or when sewage is stored in tanks does a farm become very offensive. The reason for the forming of a village was the enormous increase in the productiveness of the soil, since sewage is applied for irrigation, which fact has attracted a number of farmers.

Regarding the effect of sewage exhalations on health, there is yet much uncertainty. Two points, however, seem to be gaining acceptance: First—The injurious elements of sewage are either poisonous gases, which may act debilitating on the system, or they are specific germs, which, when entering the lungs or stomach, may produce a zymotic disease. Unless we happen to seize upon such germs in some way, or inhale sufficiently concentrated gases, no injury would be done. Secondly—There is hardly a doubt that both of these effects may be annulled, at least to a very great extent, by accommodation. The sick rate and death rate among the persons engaged in cleaning out sewers and managing sewage farms is, as far as I have been able to find out, below the average rate in cities. The most offensive duties are perhaps those of cleaning the screens in front of sewage pumps, which need constant attention on account of a possible sudden obstruction. The men engaged at this business at one of the London pumps told me that they considered the position a good one, and that there had been nearly one hundred applicants during a recent vacancy. One man had been there sixteen years, and had never been sick, save once with nausea and headache. He was robust-looking and in excellent health. The men work twelve-hour shifts, one week during the day, the other during the night. Their wages are 26 shillings or $6.50 per week. Yours truly,

RUDOLPH HERING.

BRIDGE STRESSES,

SPRINGFIELD, Mass., Feb. 25, 1882.

EDITOR ENGINEERING NEWS:

Probably many of your readers, who, like the writer, have had a good deal of intercourse with the old school of practical Howe truss bridge builders, have heard from some of them the opinion which I have found almost universal that the angle of the braces has a great effect on the lower chord strain. That is, you must use short panels (they say) and make your braces a good deal more than 45° toward the vertical, for if they are flatter they make more strain on bottom chord and pull it apart.

Of course every engineer who has looked into the matter at all knows that for a truss of given length, depth and load, the angle of the braces and number of panels has no effect on, and does not enter into the maximum center chord strain at all, which is what we provide for in a Howe bridge, and only locally affects the strain anywhere in the chord. For instance, take one truss with square panels and brace at 45°, and a similar one with double the number of pannels. The center maximum strain will of course be equal, and the strain at every panel of the first will be the same as at every other panel of the second. The only difference is that in the long panel the strain is uniform over the whole panel, and in the short panels it is composed of two increments, one of which is added in what would be the middle of the long panel.

Now, as I believe that no practice and theory of this kind grows up among practical men without *some* good reason, the subject being recalled to my attention lately, I looked into it a little and I believe the true reason for the difference in practice which they find between long and short panels is simply in the added *girder* strain. The floor system in a Howe bridge being distributed over the whole panel length of bottom chord by floor beams (instead of concentrated at panel points as is the general practice in iron), of course the girder strain in chord, additional to chord strain proper, increases in a much larger ratio than directly with length of panel, and it is just there that I think the "milk in the cocoanut" is secreted.

All this may be nothing but an old story to many of your readers, but being new to me I give it for what it is worth.

Another little point on which I should like the opinion of some of your professional readers:

In designing an iron bridge for a certain railroad, a riveted Warren girder, say 50 ft. long, 10 ft. panels, with supended oak floor beams 16 in. apart, the specifications required area for girder strain, besides net area for chord strain. The bottom chord was made of two 10½-in. channel bars, placed vertically, with vertical plates added for requisite area toward the center. Now, I figured it in this way. Provide in net area of channels and plates for the chord strain. Now the girder strain is compression above neutral axis of chord (which simply goes to counteract so much of the tensile chord strain) and tension below neutral axis, added to chord tension. Provide for this by riveting plate, say 4 × ½, horizontally under lower flange of channel of net area sufficient for girder tension.

The railroad company's engineer would not accept this; but required, first, channels sufficient to act as girders independently; then plates to meet total chord strain without reckoning channels at all. Of course he was within his right in requiring perfect safety for his company, if he had any doubts; but, as a professional question, if you were figuring down to the last pound of iron, am I right or wrong? Truly yours,

W. H. BURRALL, C. E.

THE STANDARD METRIC CHAIN.

BOSTON, March 7, 1882.

EDITOR ENGINEERING NEWS:

A description of the method of applying the metric system to the stationing of a railroad, or other similar work, will be an appropriate conclusion to the series of articles bearing the above title.

For the elementary purposes of engineering and land surveying it is customary to set stakes at every change in alignment and at every noticeable change in the surface of the ground. During the primitive days of the profession, before the wonderful development of the systems of canals and railways that has occurred during the past century, this was the prevailing method.

Each stake was marked with some designating letter or number, which was recorded in the note book in a column headed "stations," a term which at that time merely signified a point occupied for the purposes of the survey. In another column was recorded the distance from one station to another, which was measured with the Gunter chain of 66 ft. (20,$\frac{12}{100}$ meters), an implement used in common by land surveyors and civil engineers in the early days of the profession. The distances between stations were entirely irregular and arbitrary, being determined solely by accidental topographical features.

One of the earliest improvements in engineering methods caused by the rapid extension of the railway systems of England and of this country was the introduction of the practice of placing the stations at short equidistant intervals, thereby greatly reducing the labor of the subsequent computations. The English engineers, with characteristic conservatism, contented themselves with setting their stakes at such equidistant intervals as are conveniently obtained by the Gunter chain, which they retained in their field work.

The American engineers, however, introduced the decimal method of dividing the foot, adopted it as their unit of measure, and increased the length of their chain to 100 feet (30,$\frac{48}{100}$ meters).

This length was chosen, not on account of the intrinsic superiority of a measure of that absolute length, but because of the accidental feature that it comprises one hundred units when expressed in feet. Apart from this latter property, the measure is unwieldy and inconvenient.

The term "station" also gradually acquired a new signification, while still retaining its old meaning, being often used to indicate the *interval* between two stations, and, in particular, the interval given by a chain of 100 ft., which was used as the unit of stationing.

A station 100 ft. in length being only adapted to a comparatively *smooth* surface, shorter intervals are required in an undulating or rough country. On such ground, which forms the larger portion of the surface upon which engineering surveys are conducted, the stakes are often set at intervals of 50 or 25 ft., being numbered *fractionally* in terms of the station of 100 ft., and recorded in the same manner.

If, on the contrary, the length chosen for the unit of stationing had been one suitable for a *rough* surface, then the intervals between stakes on rough, undulating or smooth ground could all have been marked and recorded in *whole numbers*, or *multiples* of the unit of stationing, thus avoiding the use of fractional stations or sub-stations, except for the location of fixed objects, or in cross-sectioning excessively rough ground and simplifying the records and the marking of the stakes.

The metric system gives us a unit, the *dekameter*, well adapted for this purpose.

To obtain clear ideas upon this subject, let us, in imagination, supply ourselves with a *dekameter chain*, and run a straight line, of say five kilometers, over a diversified country, setting stakes at every *dekameter* end, numbering them consecutively from 1 to 500.

The initial point being marked zero, these numbers will indicate the distance to each stake in dekameters.

Upon inspecting this line of stakes we perceive that a survey based upon it will be of extreme accuracy, but will require a corresponding amount of labor.

We find the degree of accuracy is adapted to ground of a rough and rocky character. We will suppose the first kilometer of our line to be of this description, and aside from the introduction of a few stakes to reduce the interval to half a dekameter where the surface is exceedingly rough, no change is required on this part of the line.

The stakes on this section will therefore retain the original numbering.

After the first kilometer, we may assume that the character of the country changes, becoming undulating until it reaches some flat alluvial ground in a river valley.

Here we find that our survey will exceed the accuracy demanded, and we direct the axemen to remove every other stake, leaving only those marked with *even* numbers.

This increases the interval between the stations to 2 dekameters, and brings the amount of work required in this part of the survey within reasonable limits.

The stakes remaining upon this second section of the line are marked with the *even* numbers of the original series, as 122, 124, 126, etc.

Upon reaching the river valley, we find that the length of the station may be again increased without impairing the accuracy of the survey; and we again direct the axemen to remove every other stake, increasing the interval to 4 dekameters. The stakes on this third section will be marked with every *fourth* number, as 320, 324, 328, etc.

A review of our experimental line, as it is now staked, shows that a survey can be conducted more rapidly by means of a *double dekameter* chain than by means of the dekameter which we have used, and which proves to be adapted only to the rougher portion of the line.

We have here another illustration of the adaptability of the metric system to different kinds of work. Stations are provided for the various surfaces met with, suitable to the character of each. The numbering of the stakes and the record of the stations can be kept in whole numbers, with very few exceptions. The distance between consecutive stakes, or between distant stakes, may be had in dekameters by a single subtraction, and may be had in any other metric unit by suitably changing the decimal point. Upon preliminary surveys greater distances may be used between the stakes without losing any of these valuable features.

CHARLES H. SWAN, C. E.,
Chairman Committee on Manufactures American Metric Bureau.

NEW IDEAS IN BUILDING.

Several novel features in building have just been introduced in an eight-story business house being erected in New York by Mr. Vernon K. Stephenson. The tide of opinion in the fire department and among insurance companies having lately turned against iron beams, the owner has placed on his floors thick wooden beams one foot from centre to centre and filled the interstices with cement, thus forming a solid floor two feet in thickness, which he claims will resist the penetration of fire for several days, whereas, he says, "the iron beams would bend with the heat and fall out and the building cave in." The stairs are of slate; the walls three feet in thickness.—*American Manufacturer.*

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.

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JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR.....................ASSOCIATE EDITOR.

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Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

THE AMERICAN WATER-WORKS ASSOCIATION.—The second annual meeting of the American Water-Works Association will be held in the City Hall, Columbus, O., on Tuesday, March 14, 1882.
J. H. DECKER, Secretary.

"RULE OF THUMB" ENGINEERING.

"I am not a scientific engineer but a practical one; for sixteen years I have been engaged in railroading and mining; in California I built about one hundred and thirty miles of railroad; although I have been in caissons before, yet the tunnel work was my first experience with compressed air. I know nothing of mathematics; in my experience I have grasped such matters as a whole. I believe that the study of mathematics in that kind of work has a tendency to dwarf the mind rather than enlighten it; perhaps all my life I have been going contrary to the advice of engineers. They don't as a rule study anything practically, and all the theories they study and advance are upset in practice. I never saw any two engineers yet who would agree on any point. Mr. Brush had a theory, and as I had often found theory at fault, I paid no attention to it, but devoted myself entirely to practical work. I shall go on with the work until it either fails through entirely or it is opened to the public. This accident may teach the men in the future to be more cautious, and, therefore, in the future there will be fewer chances of a repetition of this experience.

If I were building a railroad (or tunnel) of which there were a dozen directors, I think I should take the biggest fool of the dozen and let him follow his plan." *D. C. Haskin, President and Chief Engineer (?) Hudson River Tunnel, before the Coroner's Jury, Sept. 29, 1880.*

One of the greatest engineering works of the present time is the tunnel which is being driven under the Hudson River, in front of this city, for the purpose of bringing the railway traffic, now terminating in Jersey City, into the business center of New York. After years of litigation in the courts, the tunnel construction was finally commenced about two years ago, with Mr. D. C. Haskin (whose autobiography is given above) as the leading spirit. Compressed air and an unconcealed contempt for civil engineers and their methods are Mr. Haskin's hobbies. He did for a while employ a civil engineer *by the hour* to give lines, grades, etc., but to the theories or advice of this employé he "paid no attention." One day Mr. Haskin's tunnel caved in and drowned a lot of poor fellows—an unlucky incident in the history of the tunnel, but one which was of use, inasmuch as it would "teach the men in the future to be more cautious." Jersey justice said "nobody was to blame," and after digging out the dead men and débris and spending the yearly salaries of several first-class engineers in repairing damages, the big bore was once more started, with the former small engineering force still further reduced in numbers. A change, however, apparently came over the dream of the management as it became expedient to float tunnel stock, presumably, for it was duly announced in the daily and class journals that a well-known civil engineer, a member of the American Society, then in Europe, and an expert in the use of compressed air in making deep foundations and in the construction of difficult engineering work, had been engaged to take charge of the tunnel as Chief Engineer. Under that management, with able assistants, the tunnel has been constructed for a year past, until recently it was announced in a daily journal that this Chief Engineer had resigned, which we have good reason to believe is a fact, and it is an open secret that it was because he very properly would not be figure-head only to shoulder the possible consequences of the Haskin style of engineering. If we mistake not, there is now an opportunity to buy some Hudson River Tunnel stock; before any simple-minded and trusting investor exchanges his greenbacks for such he would do well to take a stroll to the New York caisson and study the possibilities of the present method of opening that end of the tunnel; then go over to New Jersey and passing through the scene of the "recent unpleasantness" at that end, and being "locked" through to the present field of operations, let him but use his eyes and common sense in his investigation of "practical" engineering. Our reporter has given elsewhere a description of what he saw; he has not told half the story of what he saw and heard, and his diagram but imperfectly illustrates the condition of affairs in the big hole now being excavated through the river mud. Imagine a section of the roof of a great tunnel in such "silt" or soft mud as came pouring down on the doomed fellows that were caged in there over a year ago, actually built as shown by the diagram, with one end down about 18 in., a large crevice at lower end stopped up for the time being with pieces of boards to prevent the mud from coming in; if any accident happens to the air-compressing apparatus, who can tell what would be the consequences, especially as there is only *one* air-lock provided for egress, although the engineers have protested against such parsimony, and have not only protested but *put it on record*, so that they shall not be held accountable in case of future mishaps. As a journal of civil engineering, and believing in the ability of American civil engineers to take hold of such an undertaking as the Hudson River Tunnel, and with the least possible expense carrying it through to successful completion, and in view of the inevitable odium that would, for a time, be brought against the profession in case of its failure, even though civil engineers were not responsible for such, and in view of the dangers to life and the exposure to painful disease, under the present conditions of the Hudson River Tunnel, we enter our protest to its present engineering management and we wish to declare an opinion now that money is being wasted and human life is unnecessarily exposed by the present method of construction, and we furthermore believe that under the present method it will never be completed.

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WATER SUPPLY FROM LAKE GEORGE.

A bill was introduced by Senator Nelson in the N. Y. Legislature Feb. 4, authorizing the construction of the New York and Hudson Valley Aqueduct, from the Upper Hudson to the City of New York, with a capital of $50,000,000; and the paper from which we take the notice, after explaining the object of the bill, to be "the supplying New York City and the other cities of the Hudson River Valley with pure water from Lake George," adds, "That the project seems too utterly visionary for practical men to treat it with patience, and there is little doubt that it can be turned into a piece of very discreditable and damaging jobbery; and this scheme will bear watching."

Without reference to any political complexion which it may assume in any case, we surely are justified in remarking that it may be a question what bill before the Legislature of this State may not be used for jobbery? And we can scarcely imagine a bill drawn to promote any interest (and no bill would be likely to be drawn devoid of interest to some one or more) that, in its progress through the two houses of the Legislature, will not only bear, but absolutely require, watching, and that pretty severely, as times are, and we did not suppose that any member of the press of this State, or indeed of any other State, should regard it as a sine qua non that, as an antecedent to the passage of any bill through the Legislature, the abstract merits of the bill should be so apparent that all who read may understand them. It will be an era of which few of us will see the advent when this principle is a recognized one in New York legislation, and, therefore, we are not altogether surprised that the journal to which we are indebted for the notice should be slow to believe that what it did not at a glance perceive the genuineness of, had a covert meaning, in accordance with its own experience. What use may be made of the introduction of such a bill as the one above mentioned by the manipulators of the various political deals which are so rife just now, it is impossible for us to say, but we do know that the inception of the project had no political significance whatever, and no pecuniary one beyond the fact that the want of pure water in the cities on the Hudson River, including the city of New York, would render a scheme for supplying them all from a single source, if feasible within reasonable limits of cost, sufficiently remunerative.

We know nothing whatever of the personnel of this Hudson Valley Aqueduct Company—know nothing of its organization, but are acquainted with the engineer who was selected to make the examinations, surveys and estimates, the results of which we presume were sufficiently satisfactory to justify the formation of the company and their application to the Legislature for the powers requisite to the realization of the project.

The engineer is a hydraulician of more than average standing in his profession, having more than a merely local reputation, and known by name, at least, to most of his profession throughout the country. In an interview with him a month or two since, while the work of examination was in progress, and before any steps had been taken to secure the aid of the Legislature, the features of the proposed work were explained to us in general, with sufficient detail as to justify us in the belief of its entire practicability, and at a cost by no means disproportioned to the benefits to be anticipated.

The project in brief is as follows:

A dam is to be constructed over the Hudson River above Glens' Falls, say 70 ft. in height, and where the flow line will be circumscribed within comparatively narrow limits by the precipitous character of the shore line of the river. The reservoir created by this dam is to be connected by canal with a canal from Lake George, the latter by a tunnel through the dividing ridge. This will render Lake George a storage reservoir for the waters of the upper Hudson and Schroon rivers, draining some 3,000 square miles of the Adirondack region, and, by an open canal, taking favorable ground on the east of the Hudson River, convey some seven or eight hundred millions of gallons of water daily down the valley, to be distributed to the various cities on its banks as may be desired, leaving a surplus of several hundred millions of gallons daily for the city of New York. The country offers no impediment to modern engineering enterprise. The grade is favorable and the valleys admit of crossing by a system of iron pipes, the extent of which will depend upon the demand for water. The supply of water is of undoubted purity, without any possibility of contamination in its source for generations to come, if ever, and the supply unfailing to the extent named.

The precise length will depend upon whether the scheme embraces a supply direct to the city, with sufficient head for its distribution, or whether the termination would be in the present Croton Lake, thus increasing the quantity of water only, and indirectly the head in the lower part of the city by an independent supply direct to that locality. Neither the working head in the city nor the distance to Lake George as determined by the survey can we give with precision, but understand that to deliver 700,000,000 gallons into the city daily, or its equivalent, can be effected at an estimated cost of between thirty-five and forty millions of dollars, the distance being a little over 200 miles. Of course this means that, as this city will not require over 300,000,000 gallons at the maximum, the remaining 400,000,000 can be used at intermediate points in the valley.

As before stated, there is nothing so "utterly visionary in the scheme as to forbid its being entertained by practical men." Nor is the estimated cost disproportionate to the end in view. If it be decided to deliver the water into Croton Lake, the cheapest project, a new aqueduct will still be required from the city to the lake. If, on the contrary, the design be to deliver the water into the city with a working head of 200 ft. for extension of manufactures, as we are assured the levels will permit, there will, in that event, be no further need of a new aqueduct, and the city has nothing to spend, as the enterprise contemplates the construction of the work by private means. Whether the present pipe distribution will stand this increased pressure, we are not at present prepared to say, and how far with the present temper of the Legislature, in reference to the government of the city, this project may be used to antagonize that of the proposed new aqueduct and reservoir below the Croton Lake, it is impossible for any one to anticipate. That the promoters of this scheme had in view originally, and in good faith solely, the idea of providing a plentiful supply of pure water, with an increased head for manufacturing purposes, and at private cost, we have no doubt whatever, and it remains to be seen, after the details of the project become better known, how far it can be made a factor in the struggle of opposing political factions for the government of the city. That it will, if it possesses any inherent strength, be used for this purpose, all experience points as inevitable.

EAST RIVER BRIDGE.

A meeting of the Board of Trustees of this work took place on the 6th inst., and some important business was transacted. The method of the future traffic of the bridge known as the circulating system was adopted. This method consists in the operation of an endless rope in constant motion, driven by a steam engine located under the Brookly approach. The passenger cars are provided with a means for seizing this rope, and the speed of the cars becomes the speed of the rope. At the termini the cars are switched to the opposite track, and to obviate the difficulty of switching across the roadways of the bridge, the termini of the car tracks become gradually elevated on a higher platform than that of the ordinary traffic at each end, and by which, if need be, connection can be made with the elevated railroads. The speed of the passenger cars will be about 10 miles per hour, and it is estimated that 7,000 passengers can be transported each way in an hour. The time is again fixed for the opening of the bridge for traffic on the 31st day of March, 1883. This date is so alarmingly near to the first of April that the public will be very likely to consider the announcement as partaking faintly of the character of some of the previous ones—that is to say—a joke. And when they learn that the amount of money called for in order to this consummation is $1,250,000 in addition to what has already been expended, they may be slow to perceive precisely where the joke comes in. It is confidently asserted, however, that this will be the last call. We append the statement of the Chief Engineer as to the anticipated disposal of this amount, and which the Legislature will be called upon to authorize.

Statement of the amount of money required for the completion of the bridge, February, 1882:

I.—Estimated cost of completing the bridge and approaches, as follows: Liabilities on outstanding contracts for material	$565,323.73
Estimated cost of material required for the completion of the bridge and approaches, other than that contracted for	114,670.00
Salaries of officers and engineers, and cost of labor	117,632.07
Total	$797,625.80
Cash on hand Feb. 1, 1882, and due from the cities, less liabilities for salaries and material received in January	$553,557.30
Amount required for completion of the bridge and approaches in addition to the money on hand and due	244,068.50
II.—Estimated cost of elevated tracks and platforms at the termini, cost of elevated platforms, including track arrangements, ropes, waiting rooms, ticket offices, etc	268,908.00
Cost of machinery, boilers, hauling ropes, etc.	37,978.00
Boiler house	12,000.00
Rolling stock	132,000.00
Total	$450,886.00
Ten per cent. for contingencies	45,088.60
Total	$495,974.60
Added by Transit Committee	100,000.00
Total estimated cost of elevated tracks and platforms	$595,974.60
III.—Estimated cost of fitting up warehouses under the arches of the New York approach, complete for occupancy	348,184.00
IV.—Price of land in Chatham street, New York, adjoining bridge property, and agreed to be purchased by the trustees	17,500.00
Total	$1,205,727.10
Add for contingent expenses	44,272.90
Grand total	$1,250,000.00

W. A. Roebling, Chief Engineer.

The treasurer's report showed that up to the 1st of March the total receipts had been $13,543,947.19, and the total expenditures $13,496,393.74.

TEHUANTEPEC SHIP RAILWAY.

We note from a daily journal of the 4th inst. a communication from Washington that the Committee of the Senate had reported favorably on the Ship Railway bill known as the Eads Ship Railway, and with some slight amendments recommended its passage. It seems that during the third session of the Forty-sixth Congress a special committee of the House of Representatives reported in favor of this isthmean Ship Railway.

The opposition to this scheme, so far as we can judge, has arisen mainly from the friends of what may be regarded as rival projects. We do not recall the testimony of a single professional man, possessing the qualifications which would entitle his opinion to any weight, which was not influenced more or less by preconceived opinions in favor of some other interoceanic connection which would presumably suffer by the rivalry. We have already expressed our opinions at length in reference to the proper location of an interoceanic isthmean transit for ships, and used the expression "that if nature had provided a strait at the Isthmus of Darien, still, the needs of a coasting commerce would call for a communication being opened between the Gulf of Mexico and the Pacific coast in the interest of American commerce and not dominated by foreign guns."

It is well known that if a vessel leaving the mouth of the Mississippi River, bound for California or the East, crosses the isthmus at Tehuantepec, her voyage will be 1,250 miles shorter than if she crossed at Panama. If a vessel leaving New York bound for the same destination, crosses the Isthmus of Tehuantepec, her voyage will be 750 miles shorter than by way of Nicaragua, and 1,250 miles shorter than by the way of Panama. As this large saving in distance chiefly affects the commerce of this country and Mexico, and not the commerce of Europe, it must be apparent that the location of a ship transit across the isthmus is of vital interest to the United States.

That the project of Captain Eads is entirely feasible, the array of disinterested professional talent enlisted in its support should be perfectly convincing, and its location commends itself with peculiar force to all with whom the American feeling is paramount to any consideration of a mere private nature. The main features of the Senate bill are as follows: A guarantee by the United States of a dividend of 6 per cent. per annum for 15 years on $50,000,000 of the capital stock of this company, the capital stock being $75,000,000, and stipulates that the company shall transport, gratis, for 99 years, the mails, war vessels, and all other property of the United States, and shall transport American merchant vessels for one-half the rates charged by the company on all the commerce except that of Mexico. It is further provided that for any advances made by our government under its guarantee the company is to give its bonds, payable in 15 years, without interest, which bonds, in the event of their non-payment at maturity, are to be receivable for tolls on any American vessel, with 10 per cent. added to their face value. The guarantee is to attach to the extent of $5,000,000 when 10 miles of the ship railway and the terminal works connected therewith shall have been completed and tested in the presence of government engineers by the safe transportation of a loaded ship weighing 2,500 tons from the harbor to the terminus of the said 10-mile section and back again, at an average speed of six miles per hour. Another $5,000,000 is to be guaranteed when another 10-mile section, with the necessary terminal works, shall have been completed and tested at the other end of the railway. A commission of engineers, appointed by the President, is then to examine the intermediate portion of the route, and report whether or not the completion of the ship railway over it is practicable at a cost not exceeding $60,000,000. If the commission reports in the affirmative, the government guarantee is to attach (for the remaining $40,000,000 of the $50,000,000 of stock to be guaranteed) in accordance with the successive completion of the intermediate sections of the line. If the commission, however, reports in the negative, the bill provides that no further guarantee shall attach until a loaded ship weighing 4,000 tons shall have been safely transported over the entire line from ocean to ocean. The bill also provides that in determining the amount for which the government shall be liable under the guarantee, one-half of the gross revenues of the company shall be considered as net profit.

PERSONAL.

Mr. S. B. Reed, superintendent of construction of the Canada Pacific, has been appointed chief engineer in place of Gen. Rosser, resigned.

Chief Engineer John H. Long, of the United States Navy, died on Thursday, the 2d, at his residence in Astoria, aged 55 years. He was a native of England, and came to this country while a boy and was apprenticed to R. Hoe & Co., machinists. He entered the navy as third assistant engineer. Having resigned his position he began the manufacture of machinery. When the Rebellion broke out he again entered the navy as first assistant engineer. He became chief engineer and served throughout the war. He was with Farragut in Mobile Bay, at the capture of New Orleans, and on the Mississippi, where, from exposure, he contracted the disease of which he died. He was the author of a book on mechanical engineering, and was generally employed by the Government upon special duty in that branch.

ENGINEERS' SOCIETIES.

LIVERPOOL ENGINEERING SOCIETY, ROYAL INSTITUTION, COLQUITT STREET.

At a meeting of the above society held on Wednesday evening, Feb. 15, 1882, Mr. Frank B. Salmon, President, in the chair, the adjourned discussion on Mr. W. Goldstraw's paper on "Municipal Control of Streets and Buildings," read at a previous meeting, took place.

The writer of the paper, in starting the discussion, said the chief point was the necessity for a general Building Act. This necessity arose from the great number of different statutes and bye-laws. Mr. Boult had put the number at 2,000; but, considering that many towns had several sets of regulations on the subject, the number was probably nearer 3,000. Manchester was worse off than Liverpool, as the local building regulations were not so efficient. A general Act would improve the state of things in each town, and induce uniformity throughout the country. If such a measure is expedient, what are the points with which it ought to deal? The following seem to be essential:

1. Levels, width and surface conformation of new streets.
2. The materials of walls and roofs of new buildings,
3. The thickness of walls of new buildings.
4. The separation of buildings by party walls.
5. The construction of chimneys and flues.
6. The provision of open spaces in connection with dwelling-houses.
7. The dimensions of rooms and windows of dwelling-houses.
8. Projections beyond the regular line of buildings.
9. Ruinous or dangerous buildings.

There are other subjects hardly less important, which it is very desirable to treat in the general Act suggested. For example:

1. Direction and position of streets.
2. Coal-shoots, vaults and areas in streets.
3. Foundations of domestic buildings.
4. Damp-proof courses in houses.
5. Limits of height of houses.
6. Means of egress from large domestic and public buildings, including hotels.
7. Warehouses for combustible goods.
8. Strength of timbers in floors and roofs.

As it is impossible to carry out regulations unless they are precise, there must be details, clearly and positively stated. Very little should be left to the discretion of the Surveyor. In some matters, however, where rules cannot be laid down, the Surveyor must be a judge. Dangerous buildings form an example of this class of cases.

As to the question whether public building surveyors should be allowed private practice, there appeared to be, outside the metropolis, a general opinion against such a course.

On the whole, the following were fair questions for discussion:

1. Is a general Building Act wanted?
2. If so, what should be its main provisions?
3. Should those provisions be expressed in general terms, or in detail?
4. Should the building surveyors devote their whole time to the public service?

Mr. Aldridge, President of the Liverpool Architectural Society, and several members of this Society, took part in the discussion, which was of a very interesting character.

A vote of thanks to Mr. Goldstraw for his attendance and information in reply to the discussion was carried unanimously.

The Vice-President announced that the next meeting of the Society would be held on Wednesday evening, March 1, when a paper by Mr. W. E. Mills, on the "Ventilation of Dwelling-houses and Public Buildings," would be read.

FRENCH ARCHITECTS' FEES.

An important decision has lately been delivered by the Third Chamber of the Civil Tribunal of the Seine, which determines the much-disputed point, whether the fee or honorarium of an architect should be reckoned on the limit price fixed before competition or on the amount of tender accepted. M. Bourdeix, architect, had been commissioned to prepare the plans of a house for M. Jacobi. Various contractors submitted tenders more or less below the limit price, the reduction in one case amounting to over 35 per cent. As a rule, in France, the construction of a building is not undertaken by one, but by several contractors, each taking his own particular branch, such as masonry, carpenter's work, plumbing, etc. When the time for payment came, M. Bourdeix, to whom all accounts were submitted, settled with the contractors at the price of their tenders, but claimed from M. Jacobi 5 per cent. on the original limit price (*devis*). This claim was contested. The owner paid into court 5 per cent. upon the sums actually disbursed. The Tribunal, however, decided that M. Bourdeix was entitled to percentage on the full *devis*, basing its judgment on the ground that all the contractors, having tendered considerably below the limit, more care and supervision were necessary on the part of the architect to insure good quality in the work. This decision will no doubt be accepted as regulating fees, and will make a considerable difference in the incomes of many French architects.—*London Architect.*

HIGHWAY BRIDGES.

BY ALBERT F. HILL, C. E.

The rapid growth of population in the United States, consequent upon the opening up of the rich lands of the West, is steadily increasing the demand for facilities of local inter-communication. Among these the highway bridge stands foremost in importance, and the great number of this class of structures which are annually erected makes it imperative that the standard of requirements for their construction should be brought up to the level of other important public works.

Highway bridges afford exceptional opportunities for the display of correct taste and engineering ability—it is therefor to be regretted that the country should be dotted all over as it were with bridges that must be classed among the "lost opportunities." Architectural monstrosities of this kind are to be found in all our large cities, and the rural districts abound in absurdly designed, wretchedly constructed and hideously painted bridges. Cities and city parks contain many examples of bridges, the construction of which though faultless and showing great engineering skill and fine workmanship, are nevertheless from the very excuse for their existence, viz., to construct a decoration for nature, absurd-looking.

The reasons for this state of affairs are manifold. The principal one, though, is probably to be found in the fact that in most instances the men upon whom the letting and the award of work for highway bridges devolves have duties imposed upon them for which their early training has not prepared them. In this may also be found the reason for their frequently selecting engineers, who have neither experience nor education, solely because their services—such as they are—can be obtained cheaply, quite oblivious of the fact that such men can and will throw away money and insure to them wretchedly constructed work. On the other hand, it must be admitted that neither bridge committees nor their engineers are perhaps as much to blame for this as the deplorable lack of proper legislation bearing upon the construction of public works. The committees' hands are tied in most cases, not so much by want of funds as by want of authority to use funds for the employment of experts. And thus it often happens that able and efficient county surveyors find themselves charged with duties in the supervision of iron construction for which they are utterly unfit. There is nothing derogatory to them in this. The vast field covered by engineering science compels our best talent to become specialists, as in the case in any other profession.

Bridge-construction is a specialty; and unless adopted as such an engineer will probably find it exceedingly difficult to keep up with the rapid and magnificent strides of this noble art, aside from the impossibility of becoming a competent judge of material and workmanship without long and patient "shop-practice." It may, therefore, be readily imagined how easily both committees and engineers become the prey of some third-rate—or possibly no rate—concern, who offers them the "lowest bids," and of course also the poorest work.

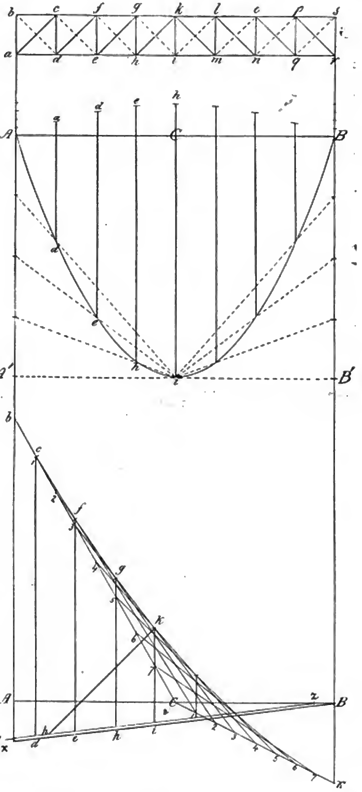
Attention has thus far been called to the characteristic defects to be found in highway bridges, and from these it is evident that what is chiefly wanted is a wider dissemination of knowledge of of the structural qualities of the materials which enter into their construction, as well as of the rudimentary elements of construction in general.

In regard to wood and wooden bridges very little need be said here. Knowledge of what good timber is, and good judgment of carpenter's work, is pretty general. If, therefore, a wooden bridge is properly designed and dimensioned by a competent engineer, there is no doubt that both material and workmanship can be safely entrusted to the supervision and inspection of "the neighborhood." That so many of our wooden bridges are short-lived and almost under constant repair is not the fault of the material or workmanship so much as of bad design. To this latter cause must be assigned the foundation for the testimony given by several county engineers in the West a few years ago, that the average life of a wooden bridge was not more than from 8 to 12 years.

This is singular evidence, considering that in this country we can point to such bridges as the Mohawk bridge at Schenectady, the Upper and Lower Schuylkill bridges at Philadelphia, the Delaware bridge at Trenton, etc., etc., etc.

The average life of all these bridges is over 30 years. But then they were designed by eminent engineers—were models of their kind of construction, and not merely the botchwork of a country carpenter.

The age of wooden bridges is rapidly drawing to a close, however, in the well-settled parts of this country, and iron structures are taking their places. And since the cost of a bridge *per lineal foot of length* increases with the length of the span, and iron bridges are so much more expensive than wooden ones, it may be proper right here to warn those in whose charge new structures may come against reverting into one of the earliest errors in bridge-building, viz., short spans. Every pier is an additional channel-obstruction, and in our often rapidly rising rivers and streams this becomes a matter for serious consideration. *Deep* foundations for abutments and piers and *long spans* are the best guarantee for the maintenance of communication and the safety of the bridge.



If but little *need* be said on the subject of wood in an article like the present, but little *can* be said on the subject of iron, beyond calling attention to and impressing upon the mind of laymen the fact that iron is a material of infinite variety of qualities, and of all construction materials the one most susceptible to treatment; that to judge correctly of its mechanical qualities from external appearances, fractures, etc., etc., requires long practice and thorough familiarity with the different processes of its manufacture.

Of all tests to which *wrought iron* can be submitted, the simplest and the one most easily applied is *cold bending*. While it furnishes no indication of the absolute strength or relative uniformity of the material, it is the best criterion of the two most important requisites—*toughness* and *ductility*. This test is made by simply bending a round or square bar, and by blows from a sledge hammer—say over the edge of an anvil—until the two ends are parallel to each other and about the thickness of the tested bar apart. If no cracks are visible at the back of the bend, after this test, the iron may be set down as of excellent quality for bridge purposes.

Another good test readily applied is to nick the bar first, and then subject it to cold bending by moderate blows. If by this process the bar develops fine fiber of silky appearance, without showing any crystal-like spots, it is of good quality of iron; if it shows such spots or snaps off short during the process of bending, it ought not to be allowed in a structure.

If a reliable testing machine is available for the purpose good bar iron ought to show on an average about 50,000 lbs. per sq. in. of ultimate tensile strength, with an elongation of not less than 1½ in. per foot, and show a well drawn out and reduced area of fracture. Angle and plate iron is usually from 10 to 15 per cent. weaker than bar-iron, and, therefore, a corresponding increase of metal ought to be demanded in their use.

Cast-iron is so unreliable a material that its use in bridge construction ought not to be tolerated, except for bearing blocks, washers and post caps; in short, in small pieces only and under compression exclusively. Good castings ought to have a smooth and close-grained surface, and when broken should show a grayish, fine-grained fracture and be free from sand and blow-holes.

Of equal importance with the quality of the material is the proper dimensioning of the parts of a bridge in accordance with the strains to which they are liable to be subjected. This of course is a matter of calculation exclusively, and entirely apart from the skill requisite for appropriately *designing* a bridge. And right here let it be remembered "there is no royal road" either to results or to success in bridge building. Innate love for the work, faithful study and downright honest hard work must all be combined, and are the *sine qua non* of tangible results. At the same time there is in the minds of many a good deal of fancied mystery surrounding the making of a strain-sheet. Now if a plain, simple and quick method of getting at the salient stresses in a structure were placed at the disposal of those, who, not being bridge engineers proper, have yet to decide upon the efficacy and correctness of bridge plans submitted for their acceptance, this might be of some service to many.

Presupposing a knowledge of the rudimentary principles of algebra and mechanics, of the fact that all forms of trussing are referable to the principles of the lever, etc.; in short, presupposing that amount of knowledge with which any elementary treatise will make the reader familiar—we may at once proceed with the work before us, viz., to find *graphically* the stresses of a given truss.

The most common form of truss in highway bridges, is that with parallel chords. We will therefore suppose a truss of the general form, *abc....rs*, to have been submitted for acceptance.

Since the bending moment is greatest when the value of the shearing force is least, and *vice versa*, the chord strains must be considered separately from the web strains. All chord strains are horizontal strains, compression strains in the upper and tension strains in the lower chords, and become maxima when the truss is fully loaded throughout its whole length. Designating by w one-half of the live load per lineal foot of bridge—that on sidewalks included—and by w' one-half of the dead weight per lineal foot of bridge—floor system, etc., included—and by l the length of the span, then will $(w+w')\,l = W$ represent the maximum load per truss. Designating further by h the depth of the truss, then will $\frac{W\,l}{8\,h}$ express the maximum stress at the centers of the chords.

To represent this graphically assume any convenient scales for lineal and for strain measures—the larger the better, say 50 ft. to the inch for lineal, and 50,000 lbs. to the inch for strain-measure—draw AB by lineal measure equal to the length of the span ar, and Ci perpendicularly from the middle of AB and equal to $\frac{W\,l}{8\,h}$ by strain-measure. To find the chord strains for the different panels, drop a perpendicular from A and make AA' equal to Ci, and divide it into as many equal parts as there are panels in the half-truss *abki*. From i of the line Ci draw straight lines to the points of division thus obtained on AA', and where these straight lines are successively intersected by verticals corresponding to the panel-points *dehi* of the truss, we obtain points of the parabola—moment-curve—*Adehi* . . . *B*. Ci represents the amount of tension in *hi* and *im* and of compression in *gk* and *kl* of the truss, that portion of the vertical *eh*, which lies between the horizontal AB and the point h is the measure of the strains in *eh*, *mn* and *fg* and *lo* respectively; the part of *de* which lies between AB and the point *e*, is the measure of the strains in *de*, *ng* and *cf* and *op*. And finally, the same part of *ad* measures the strains in *ad*, *qr* and *lc* and *ps* when the truss is fully loaded. To provide further against strains, such as loads concentrated upon short wheel bases might produce—fire engines, heavy safes on short trucks, etc.—we must consider the excess of weight of such concentrated loads over the normal weight provided for already. Let wp represent the amount of live load provided against per panel, and x one-half of the concentrated load under consideration, then will $(x - wp) = W_1$ be the load we have still further to provide against. W_1 will produce the greatest effect when at the center of the truss, and this effect will be equal to

$$\frac{W_1\,l}{4\,h}.$$

Take this amount from the strain scale, and erect the vertical

$$Ch = \frac{W_1\,l}{4\,h},$$

lay the same off on the vertical AA' and above A, divide this space into the same number of parts as AA', and obtain the moment curve as before, but above the horizontal AB, and the verticals *ad*, *de*, *eh* and *hi* will represent the full chord stresses in their respective panels.

To obtain the strains in the posts, braces, diagonals or counters, in short the *web strains*, we must remember that the shearing force at any point in a truss is greatest when the longer part of the span into which this point divides the truss is fully loaded, and that therefore the shearing force is a minimum for $\frac{w'\,l}{2}$, *i. e.*, one-half the weight of the truss unloaded and becomes a maximum for $\frac{(w + w')\,l}{2}$, *i. e.*, one-half of the weight of the truss and the full load. We now proceed as follows, namely: Again draw AB parallel and equal to ar, make Ab equal $\frac{(w + w')\,l}{2}$ and Bc equal $\frac{w'\,l}{2}$, connect the points b and c with C, and divide each bC and Cc into as many equal parts as there are panels in the truss (here eight) and number these divisions consecutively from left to right: 1, 2, 3 ....7; draw the lines 1—1, ...2—2, ...3—3, ...4—4 ...7—7, and the intersections of the consecutive lines, such as 1—1 with 2—2, 2—2 with 3—3, etc., will give points of the shearing curve at the middle of the corresponding panels, and the ordinates from AB to the points *c*, *f*, *g*, *k* ... will be the measure of the shearing stresses in these panels. To provide now for the excess of shear caused by concentrated loads take the quantity $(x - wp) = W_1$ from the strain scale, plot the same at Ax and draw the line xB, and since the shearing strain is taken at the middle of the panel move the point B to z and draw zy parallel to Bx. The lines *ch*, *fe*, *gh*, *ki*, ... will then give the full measure of the shearing stress in the corresponding panels, *cd* being the tension in tie or compression in the post *cd*,—*fe*, the tension in the tie or compression in the post *fe*, and so on according to whether we have vertical ties and diagonal braces in the truss, or vertical posts and diagonal ties. To find the measure of the strain in the diagonals, be they braces or ties, draw lines like *Kh* parallel to the diagonals, in the direction of their service, from the points *k*, *g*, *f*, *e*, and their lengths limited by the line *zy* will be the measure of the strain in them. The last point of the curve which lies *above* the horizontal and to the right of C limits the distance for which counters are required; in the diagram this is indicated by the vertical from the point 1 to the right of C.

Having thus ascertained the salient strains of a given truss—and the scope of an article like the present precludes the working out of details, etc., etc.—the next step will be the comparison of the dimensions of the parts as stated in the bid, with the strains thus obtained. Attention can be called here only to the most important facts. Remember always that different parts of a structure have different service to perform, some heavier some lighter service. To adhere rigidly to the rule that "iron shall not be strained more than five tons in tension and four tons in compression per square inch of effective section," is not only not wise, but rather otherwise, for in some parts more strain may be safely allowed and in others not nearly as much ought to be admitted. The following proportions will probably be found to agree with the best practice: For parts under tension allow, in bottom chords and main diagonals, 10,000 lbs.; in counters and long ties not more than 8,000 lbs.; in laterals, 12,000 lbs. per square inch of *effective* section.

Compression members, be they top chords or posts, should invariably be dimensioned according to either Gordon's or Rankine's formula—the latter being by far the preferable one, as giving results in better accordance with those obtained from tests. In floor-beams which are subject to transverse strains not more than 7,000 lbs. per square inch of *total* sections ought to be allowed if they are riveted girders, and not more than 9,000 lbs. if rolled beams. The shearing stress allowable in rivets and bolts should not exceed 7,000 lbs. and the pressure upon the bearing surface of the projected semi-intrados be not more than 14,000 lbs.

As regards details and connections, the greatest need for care is in the pins. Pins are almost invariably made too small, their size guessed at, rather than calculated, for the pitiable reason that proper pin-calculations take almost as much time as the calculation of the rest of the truss. For flat bars the size of pins should not be less than diameter = .8 width of bar, and for square bars diameter = 1.75 the side of the square. Next to the pins the form of the head of eye-bars is of greatest importance. There should be at least one-half more metal *through* the head than in the body of the bar, and in front of the pin the same as in the bar. As regards riveting it should be borne in mind that the thinner the web the closer ought the rivets be set, and that machine riveting is always better than hand riveting. Of the two great systems of bridges, the American or pin-connected bridge will mostly be found preferable to the English system, or riveted truss. Economy of material, almost exact workmanship, rapidity of erection, and lesser cost for false-work are its chief recommendations. Considering that the quality of the *joint* is the most important criterion of the workmanship in a bridge, and remembering the influence cramped positions and weather must necessarily have upon a riveter, the machine-made bearing and connection will invariably be found to take precedence over the field-riveted work.

Last, but not least, comes the floor system. Lack of attention to this important part of the structure is not only the cause of great discomfort in the use of a bridge; but also often leads to ultimate failure and accident. A stiff floor-system is always a pretty sure indication of a well constructed bridge.

Insist upon full provision being made against concentrated wheel-loads, and wherever possible adopt the compound riveted girder, in preference to the trussed rolled beam, as a floor-beam.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 75.

CCXXVIII.—CONCORD, N. H.

Concord, New Hampshire, in lat. 43° 15′ N., long. 71° 30′ W., is on both sides of the Merrimack River, which is bordered by rich intervale lands, bounded on the east by pine plains and on the west by rocky hills.

Settled in 1725, it was incorporated as a city in 1854. Water-works were built by the city in 1872 under the superintendence of James A. Weston, C. E., taking the supply from Long Pond, or Pennacook Lake, 3 miles from the city and from 37 to 152 ft. above it. The area of the pond is 350 acres and its water shed 3 square miles. An earth dam with a stone heart wall 2 ft. wide at top and 3½ ft. at bottom, 18 ft. high and 250 ft. long is built across the outlet of Forge Pond 2,000 ft. below the original outlet of Long Pond. An elliptical brick conduit, 24 by 30 in., extends 1,950 ft. into the lake and conveys the water to the supply main of wrought-iron and cement, 14 in. in diameter and 3½ miles long. Distribution is by 26½ miles of wrought-iron and cement pipe, with 107 fire hydrants, 137 gates and 1,731 taps; 15 meters are used. Service pipe are of cement-lined wrought-iron pipe, and connections are made with tin-lined lead pipe.

The population in 1880 was 13,843, and the daily consumption 750,000 gallons.

The works have cost $365,000. The bonded debt is $350,000 at 6 per cent. The expenditures in 1881 were, for maintenance, $2,298.84; for repairs and extensions, $1,828.18; for interest, $21,000. The receipts were $25,334.01.

The works are managed by six Water Commissioners. John Kimball is President and William M. Chase, Clerk. V. C. Hastings is the Supeintendent.

CCXXIX.—PLYMOUTH, N. H.

Plymouth, New Hampshire, in lat. 43° 45′ N., long. 71° 42′ W., is on the Pemigewasset River, which flows through a rugged region of granitic rock. The town was settled in 1754. In 1881 water-works were built by a private company, under the superintendence of W. F. Langdon. The supply is taken from two small streams fed by springs with a water-shed of about ½ square mile. An earth dam 13 ft. high and 8 ft. wide at top impounds the water in a small reservoir 90 ft. above the highest part of the village and 179 ft. above the lowest part. The supply main, 6,200 ft. long, is of 8 in. diameter, and the distributing pipes of 6 and 4 in., all of wrought iron and cement. Two miles of distributing pipe are laid, with 27 fire hydrants, 9 gates and 60 taps. The town pays $25 per year for each hydrant. Service pipes are of wrought iron, tarred.

The population is 1,100 and the daily consumption in 1881 was about 50,000 gallons.

The capital stock of the company is $30,000, and the works have cost about $25,000. There is no debt. The receipts are at present $1,500 per annum.

W. F. Langdon is the Superintendent.

CCXXX.—THREE RIVERS.

Three Rivers, Canada, in lat. 46° 22′ N., long. 72° 31′ W., is on the river St. Lawrence, at the mouth of the St. Maurice. Settled about 1620, it was incorporated as a city in 1857.

Water-works were built by the city in 1875 under the superintendence of P. N. Robichon and Henry Lor, taking the supply from the St. Lawrence and passing the water through 9 ft. of broken stone and coarse sand to a reservoir in the wharf on the river front. From this it is taken through an 8-in. wrought-iron pipe 120 ft. to a steam pump with 12-in. steam cylinder and 7-in. pump of 24-in. stroke, pumping directly into the mains, with 70 lbs. ordinary pressure and 145 lbs. fire pressure. The distribution is by 14 miles of cast-iron pipe made in Scotland, of 9, 6 and 4 in. diameter, with 58 fire hydrants, 36 gates and 1,700 taps. Two meters are in use. Lead service pipes are used.

The population in 18[illegible] was 10,000, and the daily consumption 150,000 gallons.

The works have cost $125,000, which is the amount of bonded debt at 6 per cent. interest. The receipts to 1882 have been $70,000.

In 1880 the expenses of maintenance were $12,000 and the receipts $14,000.

O. Z. Hamel is the Superintendent.

CCXXXI.—EUREKA.

Eureka, Nevada, in lat. 39° 30′ N., long. 116° 10′ W., is in the Humboldt Mountain range. It was settled in 1864. Water-works were built in 1871 by Maj. W. W. McCoy as a private enterprise. The water of springs is collected in 6 tanks, holding 250,000 gallons, and distributed by gravity through one mile of 6-in. cast-iron pipe, with 20 fire hydrants, 30 gates and 700 taps. Ten meters are in use.

The town pays $3,000 per annum for use of hydrants. Wrought-iron pipe is used for services.

The population in 1880 was 5,000. The consumption is not known.

The works have cost $60,000. No further financial statements are given.

George F. Bliss is the Superintendent.

CCXXXII.—ALPENA.

Alpena, Michigan, in lat. 45° N., long. 83° 20′ W., is on Thunder Bay, Lake Huron, at the mouth of Thunder Bay River. It was incorporated as a city in 1871. Water-works were built by a private company in 1879, taking the supply from the bay. An inlet crib of fine timbers, bolted together and filled with stone, was sunk in 16 ft. water, 1¾ miles from shore. A 24-in. Wyckoff wooden pipe conveys the water from the crib to the pump well on the shore. Another pipe brings water to the well from a pond on Thunder Bay River. One Dixon duplex pump of 9-in. bore and 18-in. stroke, and 2 Holly rotary pumps, driven by 2 Leffell turbine wheels of 87½ and 50-in. diameter, pump directly into the mains, with ordinary pressure of 40 lbs. and fire pressure of 80 lbs.

The distribution pipes are Wyckoff's wooden pipe of from 16-in. to 4-in. diameter; 9½ miles are in use, with 80 fire hydrants and 370 taps.

The population is about 5,000 and the daily consumption 405,000 gallons. This quantity is only pumped by keeping waste pipes open all the time to insure constant circulation in the pipes.

Some trouble was at first experienced with the long suction pipe to the crib. An air pump was attached to exhaust air which entered, and it works successfully.

No financial statistics are given.

W. H. Johnson is Secretary of the company.

CCXXXIII.—BETHEL.

Bethel, Connecticut, in lat. 41° 25′ N., long. 73° 3′ W., is in a valley surrounded by high hills. It was incorporated as a borough in 1848. Water-works were built by the borough in 1878, after plans of W. B. Rider, C. E. An earth dam 200 ft. long and 20 ft. high, with a heart wall of rubble masonry, impounds a small stream running through a ravine, and forms a reservoir of 33 acres area and holding 84,000,000 gallons, 170 ft. above the town and 1½ miles distant from it.

The outlet chamber is in three compartments, the first containing 200 bushels of charcoal and the second 100 lbs. of sponge, through which the water is filtered and passes into the clear water division. This filter is reported as working well. From the chamber a 12-in. pipe conveys the water through the dam, and then, reduced to 10 in., leads to the town, about 2 miles. Distribution is by 3½ miles of cast-iron pipe of from 8 to 4-in. diameter, with 28 fire hydrants, 23 gates and 180 taps. Service pipes are of galvanized iron.

The population in 1880 was 2,721. The consumption is not known.

The works have cost $28,000. The bonded debt is $25,000 at 6 per cent. interest.

The cost of maintenance in 1880 was $160 and the receipts $1,898.

The works are managed by three Water Commissioners, Eli W. Gilbert, one of the Commissioners, is Secretary and acting Superintendent.

CCXXXIV.—SCHENECTADY.

Schenectady, New York, in lat. 42° 50′ N., long. 73° 52′ W., is on the Mohawk River. It was settled in 1684, created a borough in 1765 and incorporated as a city in 1798. Water-works were built in 1871 by a private company. A filter gallery, 100 ft. long 9 ft. wide and 9 ft. high, below low-water mark in the Mohawk River and along its shore, walled and arched with brick and surrounded with gravel, furnishes clear water, except at high stages of the river, when the yield is slightly turbid. Six Holly pumps of 10-in. bore and 14-in. stroke, operated by a Holly engine, force water directly into the mains, with an ordinary pressure of 50 lbs., and fire pressure of 110 lbs.

Distribution is by 11 miles of wrought-iron and cement pipe, of 12-in. to 4-in. diameter, with 132 fire hydrants, 56 gates, 500 taps and 20 meters. The city pays $71.88 per year for each hydrant.

The population in 1880 was 13,675, and the daily consumption was 1,000,000 gallons.

No financial statistics are furnished.

Charles Stanford, Jr., is Secretary of the company.

CCXXXV.—OWEN SOUND.

Owen Sound, Canada, in lat. 44° 30′ N., long. 81° 10′ W., is at the head of Owen Sound, an arm of the Georgian Bay, on the eastern side of Lake Huron. The town, which was settled in 1840 and incorporated in 1856, is in a valley half a mile wide and a mile and a half long, with hills 100 ft. high on three sides. The Sydenham River flows through the valley and the town.

Water-works were built by private enterprise in 1880, after the plans of William Kennedy, Jr. A copious spring flowing out of the rock 2½ miles from the town, and 177 ft. above it, is conveyed by 6-in., 8-in. and 10-in cast-iron pipes to a reservoir in the town on a blue clay hill, 165 ft. above the main street. It is in excavation, lined with broken stone and washed gravel, and holds 1,000,000 gallons.

Distribution is by 6 miles of cast-iron pipe of 10-in. to 6-in. diameter, with 20 fire hydrants, 8 gates and 175 taps. The town pays $50 per year for each fire hydrant. Service pipes are principally of lead, with some iron pipe for long distances. The population is about 5,000, and the daily consumption in 1881 about 50,000 gallons.

The works cost $35,000. The expenses of maintenance are very small. The receipts are not furnished. The works are owned by S. J. Parker and R. Notter. The town has the right to buy the works in 1891, at a valuation.

CCXXXVI.—TITUSVILLE.

Titusville, Pennsylvania, in lat. 41° 37′ N, long. 79° 48′ W., is on Oil Creek, on ground sloping gently to the south and surrounded by hills about 100 ft. high. It was incorporated as a city in 1866. Water-works were built by the city in 1873, under the superintendence of M. E. Bassett. The supply is taken from two wells 16 ft. in diameter and 22 ft. deep, dug in a gravel stratum near the creek. A Holly steam engine and pumps deliver the water directly into the mains, with an ordinary pressure of 40 lbs., and fire pressure of 65 lbs. A new rotary pump was put in in 1880. Distribution is by 9 miles of cast-iron pipes, of from 15-in. to 4-in. diameter, and some 2-in. wrought iron. There are 65 fire hydrants and 625 taps; 7 meters are in use. Service pipes are of wrought iron. The population in 1880 was 9,046 and the daily consumption 904,000 gallons.

The works cost $148,625. The interest, extensions and maintenance have cost $165,224.95 to Dec. 31, 1881. The gross receipts to that date have been $51,870.81. The bonded debt is $136,265, with interest at 8, 7, 6, and 5 per cent. The expenses of maintenance in 1881 were $9,052.58, and the receipts $8,414.21

S. C. Roof is the Secretary and G. W. Angier the Superintendent.

CCXXXVII.—MIDDLETOWN, CONN.

Middletown, Connecticut, in lat. 41° 33′ N., long. 72° 40′ W., is on the Connecticut River, on ground rising from the river westward, 175 ft. in ¼ mile. It was settled in 1650 and incorporated as a city in 1784. Water-works were built by the city in 1866, after the plans and under the superintendence of George A. Bishop, C. E. An earth dam across a ravine impounds the drainage of ½ square mile in a reservoir covering 76 acres and averaging 10 ft. in depth, 168 ft. above the main business street of the city, and 45 ft. above the highest residence district. For filtering the water, a double wall of brick, filled in with stone and gravel, was provided. There is no way of cleaning this filter, and during the hot weather the water is better outside than in the filter. Distribution is by gravity, through 17¾ miles of pipe. The first pipe laid was of wrought iron and cement. Later extensions are of cast iron. There are 85 hydrants, 100 gates and 1,500 taps; 5 meters are used. Service pipes are of galvanized iron. The city pays from taxation $30 per year for double hydrants and $25 for single ones.

The population in 1880 was 11,731, and the daily consumption 750,000 gallons.

The cost has been as follows, from 1866 to 1882:

Construction	$227,408.16
Maintenance	39,984.21
Interest	153,851.51
Total	$421,243.88
Bonded debt (at 6 per cent. interest)	138,500.00
Receipts to 1882	170,040.57
Expenses in 1880	12,578.62
Receipts in 1880	15,417.29

The works are managed by a Board of Commissioners. John C. Broatch is the Secretary and Superintendent.

CCXXXVIII.—NEW BRIGHTON, PA.

New Brighton, Pennsylvania, in lat. 40° 44′ N., long. 80° 22′ W., on Beaver River, 3 miles from its junction with the Ohio River, is on three benches or terraces, each about 100 ft. high. It was settled about 1800.

Water-works were constructed in 1880, by Joseph Flannery, for a private company, taking the supply from springs under the bed of the Beaver River, a large caisson or well being sunk and tightly enclosed to keep out the river water, and pumping by a Worthington duplex pump driven by water power into a reservoir 312 ft. above the river. A steam pump built by Wilson, Snyder & Co. is used when the water power is not available. The reservoir holds 1,000,000 gallons.

Distribution is by 10 miles of cast-iron pipe of from 10-in. to 3-in. diameter, with 51 fire hydrants, 20 gates and 250 taps. Lead service pipe are used. The town pays $50 each per year for hydrants.

The population in 1880 was 4,214. The consumption is not stated.

The stock of the company is $50,000, and there is a bonded debt of $25,000, bearing 6 per cent. interest.

Further financial statements are not furnished.

R. E. Hoopes is the Treasurer and Superintendent.

(TO BE CONTINUED.)

The receipts of statistics, as follows, is acknowledged with thanks:

From Henry Scheld, statistics and water rates of the water-works of Yreka, California. From W. F. Langdon, agent, statistics and water rates of Plymouth, N. H., Aqueduct Co. From George P. Meneely, president, statistics and water rates of the water-works of West Troy, N. Y. From Jacob L. Kuehns, superintendent, statistics of water-works of York, Penn. From George H. Lincoln, superintendent, statistics and water rates of the water-works of Big Rapids, Mich. From John C. Broatch, secretary and superintendent, statistics of the water-works of Middletown, Conn. From the water commissioners, full set of reports, statistics and water rates of the water-works of Concord, N. H. From M. V. B. Rowley, manager, statistics of water-works of Lyons, N. Y. From E. Hibbard, clerk of Water Co., statistics and water rates of the water-works of Schenectady, N. Y. From W. D. Middleton, superintendent, report for 1880, water rates of the water-works of Camden, N. J. From Caleb Lombard, general agent, statistics of the water-works of Chelsea, Mass. From S. J. Parker, statistics of the water-works of Owen Sound, Canada. From S. C. Roof, secretary, reports for 1879 and 1881, statistics and water rates of the water-works of Titusville, Pa. From P. S. Williams, secretary, statistics of the water-works of Stroudsburg, Pa. From R. E. Hoopes, superintendent, statistics and water rates of the water-works of New Brighton, Pa. From S. D. Miller, superintendent, statistics and water rates of the water-works of Oil City, Pa. From Mark H. Richards, president of Gas & Water Co., statistics and water rates of the water-works of Pottstown, Pa. From F. F. Forbes, superintendent, the report of the water board of Brookline, Mass., for year ending Jan. 31, 1882. From S. P. Axtell, secretary, the eleventh annual report of the trustees of the water-works of Columbus, O.

LITERATURE.

Engineers and Mechanics Pocket Book, Forty-first edition, revised and enlarged, by Chas. H. Haswell, civil engineer, 1882.

It is scarcely necessary to say anything in commendation of this well known and fully appreciated hand book for engineers. The fact of the forty-first edition being called for indicates pretty clearly the value hitherto set upon it by such as have had occasion to consult its pages. Notwithstanding the increased number of such aids which have appeared since the issue of the first edition we have always kept a copy of this one on our shelves, as containing matter which, if found elsewhere, was still more accessible in point of arrangement and clearness of type and diction, in Haswell than in any of its rivals. The present edition of 720 pages, besides other matter, which has been revised and rearranged, to the exclusion of matter out of date, is peculiarly rich in all that pertains to steam engines and boilers, whether stationary or locomotive, simple or compound; and we recommend the "Pocket Book" as one entitled to a prominent place in the library of all interested in the mechanic arts.

SEWERAGE OF EUROPEAN CITIES.*

(Continued from page 62.)

BERLIN.

Population.—1840, 300,000; 1860, 600,000; 1880, 1,118,630.

Area.—Municipal, 15,629 acres; area of lowland, 9,983 acres; area of highland, 4,645 acres; area built up, 6,450 acres.

Dwelling.—Number of houses, about 21,000; number of dwellings to one house, 11.5; average number inhabitants per dwelling, 4.6; average number inhabitants per house, 53.

Water Supply.—Pumped from River Spree, 31.7 gallons per head daily.

Mortality.—Average for a number of years, 30.6. There has been a gradual decrease from 1872, when it was 32.6, to 1879, when it was 27.7—the lowest rate since 1867.

Meteorological.—Temperature, mean annual, 48.20 Fahrenheit. Lowest daily mean, 1850, Jan. 22, —2.44; Highest daily mean, 1865, July 20, 85.18; coldest observed temperature, Jan., 1823, —28.06.

Rain.—Annual mean, 22.32 in.; number of rainy days per annum, averaged for several years, 118.

Maximum storms, July 11, 1858, 2.56 in. fell in 14 hours = .003 in. per minute; .80 in. fell in 20 minutes = .040 per minute.

Topographical.—Situate on both banks of the Spree, a small river rising in Central Germany, and a few miles from its confluence with the Havel River. Low water in the Spree is about 95 ft. above mean tide in the Baltic. The discharge of the Spree, which averages from 100 to 200 ft. in width, is at—

	Cubic feet per second.
Ordinary low-water	1,000
Extreme low-water	500
Ordinary high-water	2,000
Extreme high-water	4,808

The river runs through the city in several arms.

Physical.—The city is closely built up in the central and eastern section. The western contains the parks and villa-residences. The streets are comparatively wide, and are mostly paved with stone blocks. Recently asphalt is being much used.

Geological.—In the older city and lowland the surface to a depth of 5 ft. is of recent formation, either dug over or filled in. Below is alluvial sand from 11 to 40 ft. thick, and below this is diluvial loam and coarse gravel, rising to the subsoil water-level at a few places in the lower city. Near the river there are occasional beds of peat and of infusorial earth in depths of 8 to 26 ft.

Management of Public Works.—Each department is headed by a chief engineer, responsible to the municipal council. The design and construction of the new sewerage works are under a special and temporary department. Other matters and the execution of the works are in charge of division engineers, one for each main drainage area (radial system), who have each a corps of several assistants, according to amount of work.

Design and Construction of Sewerage Works—General System and Alignment.—Combined water-carriage and disposal on sewage farms. As all sewage requires pumping, and as the surface of the city is extremely flat and low, it is divided into 12 independent artificial drainage areas or districts to obtain better gradients and less depth of sewers. Each one is called a "radial system," and they are numbered from I. to XII. The city proper is covered by five, I. to V.; the rest are peripheral.

The sewage from each district is collected at a lowest point, the pumping station, and from here raised through iron mains to either of two farms, one situated to the northeast, the other to the south of Berlin. The stations are situated at or near the river or one of its branches, and the sewers radiate from it over the district. At present only Radial System III. is finished, I. and II. are nearly so, and others have been commenced. The pumps are intended to raise besides the sewage only a first flush of rain-water; therefore numerous overflows are provided to relieve the pumps of any greater quantity. On broad streets, over 60 ft. in width, a sewer has been laid on each side. All sewers are as much as possible connected with each other, and temporarily separated only by valves, in order to avoid dead ends, to flush lower from higher mains (Lindley principle), and to permit the sewage to flow into other sewers in case of stoppage in any one. All pipe sewers are laid in straight lines between man-holes (Rawlinson principle). In general the sewers are divided into collectors, which are deep and built of brick, into pipe sewers for the branches and higher districts, and into storm-water overflows, for which partially old sewers were made use of. The present plan was adopted in 1873, after an inquiry of a commission appointed in 1867. The system is designed by Mr. Hobrecht.

Shape and Size of Sewers.—Circular pipe sewers are used up to 20 in. diameter. Brick sewers are egg-shaped, except some of the larger ones, which are circular, or flat elliptical for want of sufficient height under street. The width of the egg-shaped section is two-thirds its height. The pumping mains are of iron and 1 meter diameter each, except one, which is only three-quarters of a meter in diameter. The size of the sewers is determined by Eytelwein's formula in the following form, for meters:

Circular sewers, running full, $v = 50\sqrt{\frac{r}{2}s}$

$$Log.\ D = 2.0456 + \frac{5\ log.\ r + log.\ s}{2}$$

Egg-shaped sewers, running full,

$$v = 50\sqrt{\frac{4.394}{7.93}rs}$$

$$Log.\ D = 2.2426 + \frac{5\ log.\ r + log.\ s}{2}$$

Egg-shaped sewers, ⅔ full,

$$v = 50\sqrt{\frac{3.023}{4.788}rs}$$

$$Log.\ D = 2.0903 + \frac{5\ log.\ r + log.\ s}{2}$$

in which v equals velocity in meters per second; r is the mean radius; s the sine of the slope, and D the discharge in cubic meters per second. The quantity of rainfall used for calculation is ¾ in. per hour, of which ⅓ is assumed to evaporate, ⅓ to penetrate the ground, and the remaining ⅓ (7 millimeters per hour) to enter the sewers.

The quantity of sewage estimated is 130 liters (30 gallons) per day per inhabitant, of which one-half runs off in 9 hours, and for 800 inhabitants per hectare (324 persons per acre). At present there are only half this number. The minimum size for pipe sewers is 8 in.; maximum, 20 in. The brick sewers are classified into eleven types, varying from one meter to two meters in height.

Depth and Grades.—The depth of cellars was regulated by the subsoil water, which stands at + 1 meter above mean water near the river, and at + 2.2 meters at the upper end of the lower city. Cellars must be 1 ft. above subsoil-water level. Depth of pipe sewers varies from 1 meter to 4 meters below surface, and of brick sewers, which are laid deeper to act as collectors, from 2 meters to 5 meters. The latter are often below subsoil-water, and are made water-tight with great care. The grades are, as a rule, very light, on account of the flatness of the country. The minimum grades used are for:

Sewers that can be walked through	1:2000
Sewers that can be crawled through	1:1800
Pipe sewers	1:800

Pipe sewers frequently have a drop in the man-holes.

Junctions, Connections, Overflows, Outfalls.—The junctions of large sewers are generally made at right angles, except where streets join at acute angles. They are usually in rectangular chambers, with a cylindrical arch, and in a few of which there is a tongue. Funnel arches are avoided. When curves are made to enter the chamber, they mostly have a very short radius. No allowance is made for loss of head in the curves. Overflows, of which there are a great number besides those at the pumping stations, are arranged so that they can be adjusted, with regard to the height of water in the river, by iron bars of square section (2 in. by 2 in.), which are placed loosely on each other across the opening and form a dam, which, therefore, can be raised and lowered any distance at pleasure. These dams are used to prevent the ingress of river-water during its high stages. There are two ultimate outfalls for the sewage—one on the Osdorf farm, the other at the Falkenberg farm. At present much of the sewage still flows into the Spree.

Ventilation.—The ventilation of sewers is achieved by perforated man-hole covers in the middle of the street, by the street gully inlets and by the soil pipes of the houses. No objectionable odor has been noticed to arise into the street, and the air in the sewers themselves has but a slight smell.

Man-holes.—The man-holes are generally situated directly over the sewer and are covered by a circular cast-iron grating, open near the periphery and containing blocks of wood in the middle for deadening noise. One inch or two below the cover is a sheet-iron plate to catch street dirt, with holes for ventilation in the middle. The man-holes are descended by cast-iron steps set into the wall. Man-holes are placed at all street crossings and changes of directions; otherwise they are from 200 to 300 ft. apart.

Gullies.—The gullies have a horizontal inlet in the gutters, the grating being 15¾ in. by 19¾ in. They have a catch-basin 26 in. square and 34 in. deep below the outlet. The entire depth of the gully is 7 ft. 4 in. below the gutter. Gullies are never placed at intersections or near crossings, but in the block.

Pumping Stations.—There is to be a pumping station for each radial system. It is intended to pump, besides all sewage, an amount of rain-water of equal quantity. The following notes refer to system III., as it is the only one entirely finished. The rest will be in similar proportions. The station contains buildings for engines, boilers, coal, employés, etc., a well for water of condensation, a large circular catch-basin, with screen and an overflow to river. There are 6 engines (Woolf's horizontal), two coupled to one fly-wheel, with a total of 380 horse-power, driving six pumps, with a capacity of 1,000 cubic feet per minute. Only three of the pumps are ordinarily in use, the other three being kept for rainy weather. In 1878, 4,839,400 cubic meters were pumped to Osdorf, requiring 25,500 hectolitres coal at a cost of 33,500 marks (1,278,280,000 gallons, with 3,330 cubic yards coal, costing $8,400). The lift to the southern farm, Osdorf, is 75 ft.; to the northern farm, Falkenberg, 105 ft.

Miscellaneous.—For crossing the canals there are four pipe bridges and one inverted syphon.

Materials and Construction.—Materials used for sewers are pressed brick and terra-cotta pipe. The ordinary sewers are all pipe; the main collectors are brick.

The brick-work is made water-tight with the greatest care, because all of the ordinary flow of sewage must be pumped. Wedge-shaped bricks are used for arches, of four patterns for diameters from 1 meter to 2 meters. Bricks molded to circular curves, both headers and stretchers, are used for man-holes. Size of ordinary bricks is 9¾ in. by 4¾ in. by 2½ in. Pipe sewers are also laid with greatest care, from the lowest point upwards. The pipes are jointed with gasket and puddled blue clay on the outside, and cement from the inside if the pipe is large enough. This jointing has given perfect satisfaction. The foundations for sewers are usually concrete, from 1 ft. to 2 ft. 6 in. deep.

Statistics.

Radial system.	Area, acres.	Inhabitants, about.	Houses.	Inhabitants per house.	Inhabitants per acre.
I	670	103,000	1,190	87	158
II	802	107,000	2,860	58	192
III	964	107,000	2,890	37	110
IV	2,130	244,000	4,080	60	113
V	1,819	194,000	2,820	69	106
VI	1,001	46,000	720	64	46
VII	612	36,000	770	47	55
VIII	1,413	20,000	300	67	14
IX	1,258	11,000	240	46	9
X	971	35,000	550	64	36
XI	828	6,000	110	55	7
XII	430	8,000	120	67	18

Length of sewers finished December, 1880:

	Miles.
Pipe	113
Brick	13

Dwellings (not houses) connected, 30,000.

Distance from pumps to southern sewage farm, 8 miles.

Lift of pumps, 70 ft.

Sewage reaches farm from extreme dwellings in 5 hours.

Greatest calculated dilution of sewage at the moment when overflows begin to act, 1 to 8.186.

Greatest dilution when sewers are running full, 1 to 153.2.

IN HOUSES.

Sewer connections are obligatory, since 1874, as soon as sewer is laid in front of property. All excrements, waste and rain-water must be led into sewer. Cess-pools are prohibited. Owners must submit a plan of a complete house-drainage for examination; and it must be executed within six weeks after approval. The execution is subject to rigid inspection.

Disposal of Sewage.—All of the sewage is to be pumped and distributed over two farms for irrigation and filtration: one to the northeast, for the part of the city north of the Spree; the other to the south, for the southern portion. The former is at Falkenberg, 6 miles from the center of Berlin, with an elevation of 102 ft. above the Spree, and an area of 1,880 acres; the latter is at Osdorf, 9 miles from the center of Berlin, with an elevation of 72 ft. above the Spree, and an area of 2,050 acres.

A novel feature are the winter basins into which the sewage is turned, after vegetation ceases, to a depth of 2 ft., and allowed to soak away. The odor from them is very great, but no houses are within a mile. In the spring the ground is plowed, and summer grain of excellent quality grown upon it. The Falkenberg farm is not yet prepared. Osdorf receives the sewage from Radial Systems I., II. and III. through two mains, 1 meter in diameter each. The farm is divided into fields, meadows, vegetable gardens and winter basins, which are fields in summer. About 1,000 acres are at present prepared and operated. About 0.27 gallon per second per acre is delivered to the farm. The city owns and operates the farms. Irrigation was begun systematically in 1873.

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*Mr. Rudolph Hering's Report to National Board of Health, 1881.

MAINTENANCE OF SEWERAGE WORKS.

Appliances.—Pen-stocks are not used. The pipe sewers are flushed by having wooden plugs inserted and drawn when sufficient water has accumulated, or by using flaps for the same purpose. The large brick sewers are cleaned by hand with scrapers and shovels.

Method.—About every two weeks all pipe sewers are flushed, generally with hydrant water. For this purpose the ends of the pipes in a man-hole are closed either by flaps or plugs, the man-hole itself is filled with water by a hose attached to the nearest fire-plug, and the flap of the lower pipe is raised, which allows the water to rush through it with an initial head of 6 to 10 ft. Beginning at the highest point the silt is flushed from section to section until it is discharged into the brick sewers, where the greater quantity of water and the average velocity of 1 ft. 8 in. generally removes most of the sediment. The brick sewers are inspected, walked through and cleaned once in three weeks. The cleaning in the principal streets is done at night. One gang cleans about 660 ft. of pipe in one night, and removes ½ to 2 cubic yards of silt.

In 1878 there were pumped from System III. to the farm 3,505,150 gallons; in 1879, 3,716,604 gallons. In the latter year this quantity has been estimated to consist of 9.1 per cent. rain-water, 1.6 per cent. of water used for flushing, the rest of sewage proper, being 1,358 gallons per house and 32 gallons per head daily.

COST OF SEWERAGE WORKS.

Construction.—Total cost of radial systems up to 1880:

I.	Rad. system nearly finished	$1,225,000
II.	" " " "	1,575,000
III.	" " finished	1,526,000
IV.	" " nearly finished	2,400,000
V.	" " " "	2,150,250

Cost of materials: 1,000 bricks cost $7 to $10; cement is worth $2.25 per 400 pounds; iron pipe, 2 cents a pound; puddled clay, ready for use to join pipes, $6 to $8 per cubic yard; traps for house connections, $4.50, including laying; 1 square yard of sheet-piling in place costs $1.75.

Cost of labor:

Laborers, 5½ cents per hour.

Mechanics, 8½ cents per hour.

Excavation costs 30 cents a cubic yard above, and 60 cents below subsoil-water, including pumping.

Brick sewers, 3 ft. 3 in. by 2 ft. 6 in., cost $5.40 per running foot.

Pipe sewers, 20 in. diameter, cost $3.08 per running foot.

Branch pipes to houses are laid at owner's expense.

Cost of ground for Osdorf farm, per acre	$166
Cost of preparing ground, per acre	62
Cost of carriers, per acre	62
Cost of subdrainage, per acre	45
Total per acre	$335

Total cost of farm (2,050 acres), $686,750.

CORRESPONDENCE.

CENTER OF GYRATION.

Editor Engineering News:

In your issue of March 4 you seem to intimate that the use of radius of gyration is mere "nomenclature" and "affectation of precision," and that Rankine makes no mention of it in his A. M. This is, I think, erroneous. Its use is principle, not nomenclature, and Rankine does use it. On page 364 he states that in place of $\frac{l^2}{h^2}$ we must put $\frac{l^2 S}{12 J}$ where J is least moment of inertia. Now $\frac{J}{S}$ is r^2 or square of radius of gyration, as he defines it on pages 514, 515 of A. M. He doesn't mention it by name on page 364, probably because he has not yet defined the term. But this is of little consequence, as he really uses it.

The formula $\frac{l^2}{h^2}$ you seem to like so much is but a special case of a more general formula. There is no special "principle" in $\frac{l^2}{h^2}$, but there is in $\frac{l^2}{r^2}$. You thus seem to me to be in the position of advocating a special case and at the same time rejecting the general formula from which that special result is derived.

You ask the practical advantage of $\frac{l^2}{r^2}$. It is simply that for such sections as ┐ ∩ + T I, etc. We do not know what to take as the "least diameter." What would you take it in such cases? If then $\frac{l^2}{r^2}$ enables us to apply the formula to cases to which $\frac{l^2}{d^2}$ does not apply, is there not some real advantage in its use?

Let me illustrate. In the general formula for P of Gordon, the form of which is theoretical, although the constants are empirical, the moment of inertia J occurs. Now, this is always equal to Ar^2 where A is area. Hence unit strain $\frac{P}{A}$ comes out *generally* as a function of r^2. But in the *special case* of a rectangular section $J = \frac{1}{12} bd^3 = A \frac{1}{12} d^2$, and hence $\frac{P}{A}$ in *this special case* comes out as a function of d^2. Now, to accept the latter result as general and condemn the other as "affectation" seems to me, if I may say it without intending to be offensive, a good illustration of what too often happens when a "practical man" gets hold of a formula without knowing its derivation.

First he misapplies it and overestimates its generality. Second, he regards the more general form, which really lies at the basis of his own formula, with suspicion. He may even talk contemptuously of "nomenclature" and "affectation of precision" and "wiseacres," and intimate that the latter rather like to muddle up his simple formulas with learned terms without real value. How unjust this is may be seen from the above, and the impression it gives those who understand the position is not favorable to the "practical" man.

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[A. J. D. B., asks, "What is a wiseacre?" According to Webster, the first or leading definition of wiseacre is, "a learned or wise man," as, "Pythagoras learned much, becoming a mighty *wiseacre*." Now it is true we had no reference to this meaning of the word when we used it; indeed, had we known there was any ambiguity in the import of the word, we should have sought other expression for an idea which would be more in accord with the second definition of Webster, *viz.*: "One who makes undue pretension to wisdom," not applying it by any means to Rankine, who laboring in his vocation unquestionably exhibited great learning in a chosen field. But some of his admirers have mistaken a parrot-like facility on their own part for adopting the form of speech of their master, for the wisdom which was presumed to lie behind it. These are the wiseacres to whom we had reference.

A. J. D. B.'s letter which appeared in Engineering News of the 4th inst., under signature *, was not seen by us until it appeared in the page proof, too late for answer in that number, but the above taken in connection with our article on the "Radius of Gyration" in number 9 of the News, will, we hope, be considered as satisfactory.

The latest communication, which appears in the present issue under the signature "*," from the same source, calls for notice, and we gladly avail of this occasion to define our position on this and kindred branches of quasi science, which appears in the editorial columns for this week under the head of "Applied Mathematics."

We return to "*."

In our answer to a correspondent in the issue of March 4, we referred to Rankine's formula for strength of columns, and quoted from p. 362 of his A. M. (our copy 3d edition, 1864) for the formula known as Gordon's, which Rankine recommends for use in determining the strength of pillars and struts, wherein he states positively, in italics, as follows: "That the additional stress due to bending is to the stress due to direct pressure in a ratio which increases as the square of the proportion in which the length of the pillar exceeds the least diameter;" and it is the presence in this formula of a recognized ratio between the length and least thickness of columns, when considering their strength to resist bending, that we said that this "formula carried on its face a principle." In the article which follows, p. 363, a table is introduced for practical use, wherein the different ratios of $\frac{l}{h}$ are the headings of the columns for the varying coefficient of wrought and cast-iron, and so far from $\frac{l^2}{h^2}$ being regarded by him as a special case of a general formula, he has no other to offer at that date more general than those of Gordon's, and explains it as founded on a mode of investigation partly theoretical and partly empirical, derived from a theoretical formula of Tredgold, which had fallen into disuse, and which Lewis Gordon had revived by determining the constants by comparison with those of Hodgkinson's experiments. The empirical formula of the latter, derived from some hundred experiments on wrought and cast iron and steel is also given, both in this and his work on engineering, and we would remark parenthetically that the value of these experiments is still recognized by practical engineers, and in the 41st edition of "Haswell's Engineers' and Mechanics' Pocket Book," issued within the past week, in a revised form brought down to date, no other formula is given for the strength of columns and struts than that of Hodgkinson.

But to return to the radius of gyration. Nowhere in the third edition of Rankine's "Applied Mechanics," nor in his "Engineering" does the radius of gyration appear as a factor in computing the strength of columns, but its investigation is confined wholly to rotating bodies. But in Rankine's "Useful Rules and Tables," published a couple of years subsequently, no reference is made to any other than the new formula for pillars and struts, viz.:

$$\frac{P}{S} = \frac{f}{1 + \frac{l^2}{cr^2}}$$

and tables are given for various values of r^2, which method, being in its derivation highly analytic, was undoubtedly well suited to exercise the faculties of the students of Glasgow University, and so far served a purpose there as elsewhere; but unless translated into the vernacular is of but little use to the engineer, without the latter has a talent for abstruse calculation. The engineer must not take the mere dicta of mathematicians for his factors, but must understand their meaning as well. The following is the simplest explanation (from Trautwine) of the meaning of this r^2:

"Suppose that the shortest distance from the axis of a body supposed to revolve to each individual particle of the body has been measured; also that each of these distances has been squared, and that each square has been multiplied by the weight of the particle to which the distance was measured; also that all these last particles are added into one sum; that sum is the moment of inertia of the body. In practice, suppose the body to be divided into portions of a cubic inch or some other size, and use these instead of the theoretical infinitely small particles. When the moment of inertia of a surface instead of a solid is required, the surface must be supposed to be divided into an infinite number of small areas which must be used instead of the weights of the particles of the solid body. If the moment of inertia is divided by the weight of the entire solid body, or by the area of the entire surface, as the case may be, the square root of the quotient will be the *radius of gyration* of the body or the surface. If the length of the radius of gyration be laid off perpendicular from the axis, it will reach to the center of gyration, the moment of inertia of a body being its weight into the square of the radius of gyration."

Now we submit that there is a complexity about this r^2 which does not obtain in the use of d^2 in Gordon's formula, and which can only be justified upon the supposition that greater accuracy is thereby attainable, or that the determination of the value of d is not sufficiently assured in all cases—neither of which is the fact; for computations by either method in the sections ordinarily in use give sensibly similar results; while if the engineer be unable to determine by inspection in which direction a column is most flexible in order to fix the value of d for substitution in Gordon's formula, the use of the least diameter of the figure as a circle, within its bounding surfaces, if taken for this value of d, will give as reliable results as by any other known method, particularly as a factor of safety is indispensable by either method.

The complacency with which "Young America" regards his presumed success in grappling with the arcana of applied science is truly refreshing, and we are not disposed to repress the evidences of his progress, such as it is, but would suggest that the comments of "*" upon our presumed ignorance of what has been accomplished in scientific investigations would have been equally happy without the unbecoming sneer at a highly respectable though humble class of truth-seekers; and in response to his last paragraph in particular we have great cause for regret that we should have unwittingly given one whose knowledge of the subject is so vast an unfavorable impression of "practical men."]

THE SHAPE OF OUR EARTH.

Cincinnati, March 8, 1882.

Editor Engineering News:

My attention has been called to certain remarks in your issue of Feb. 25 upon my paper on *the shape of the earth.* Those remarks seem calculated to convey the idea that the inequalities in water-level caused by mountain ranges are insignificant in amount, an idea as widespread as it is erroneous.

The assertions made in my paper, and which I now reaffirm, were not made, as you seem to think, upon the strength of mathematical symbols alone, but upon competent observations and numerical calculations of the amount of such inequalities. I regret that the abbreviated report which came under your notice did not contain at length the statements in the original paper. Permit me now to detail some of the facts upon which that part of my paper was based.

And, first, it has been discovered that local attractions deviate the plumb line in almost all localities on the earth's surface to measurable amounts from the direction it would have were the earth an homogeneous ellipsoid of revolution. Deviations as great as 30″ of arc have been observed, and deviations of one-half or one-third that amount are not infrequent, even in comparatively level country. Now. what does this imply? Assuredly, it signifies that water level has a slope of that amount at that locality; and that the common observation, "water runs down hill," is a mistake, for it would certainly run up hill at such places. It further signifies that the astronomical latitude of an observatory, determined in the usual way, by reference to the plumb-line, would be erroneously determined to the full extent of the north and south deviation of the plumb-line. Were that 15″, the observatory would be 1,500 ft. and more north or south of its supposed parallel. I cannot regard nearly one-third of a mile an insignificant error, in comparison with that permissible in such a determination, which is a few feet at most. The facts as to the deviation of the plumb-line can be verified in the reports of our Coast Survey and other like surveys in Europe and India.

A parallel of latitude run by the plumb line and stars alone would bear a striking resemblance to a ribbon in the wind.

Secondly, a computation has been made by the distinguished physicists, Thomson and Tait, the results of which are to be found in their Treatise on Natural Philosophy, page 638, vol. 1, first edition, where it is stated that "a set of several broad mountain chains and valleys, twenty nautical miles from crest to crest, or hollow to hollow, and of several times twenty miles extent along the crests and hollows, and 7,200 ft. vertical height from hollow to crest, would raise and lower the level by 2½ ft. above and below what it would be were the surface levelled by removing the elevated matter and filling the valleys with it."

In such a very moderately mountanous country as that supposed, the surface of water would then present a series of crests and hollows 20 miles apart, in which each crest would be 5 ft. above the bottom of the hollow. Now, Mr. Editor, if that be called an insignificant deviation, I beg leave to say that I cannot so consider it. And the statement is on the authority of Sir William Thomson, the first mathematical physicist of the age.

Should you still doubt the accuracy of these statements, please question my esteemed friend Professor Merriman, whose name you mention, or any of the eminent geodetists of our Coast Survey, who are practically familiar with the matter.

Yours very truly, H. T. Eddy.

[The above writer is assured that our remarks on this subject, to which he takes exception, grew out of no distrust whatever as to the entire correctness of his statements as to the fact or the principle involved, and we are happy to find that they were effective in eliciting comment from one so well qualified to give the needed light upon the subject.]

TUNNELS VERSUS BRIDGES.

Portland, Or., March 1, 1882.

Editor Engineering News:

I ask the privilege of bringing the following before the civil engineers:

I believe that a vast saving could be made in time and perfect safety accomplished by adopting the plan of tunneling the rivers instead of bridges. Many years ago we had to haul the iron across the Brazos River, in Texas. As it was necessary to get it across the river in order to get the bonus of $6,000 per mile, we built a pile bridge in the river, which was over 40 ft. below the bank; adopted vertical curves, laid the track and did our work without accident. The impetus of the cars going down forced them up on the opposite sides; our levels were equal on both sides.

Now, sir, this plan I wish to bring to the notice of engineers, as it would be safer than bridges where they must have long spans and way for boats, which are always liable to accidents. The tunnel would cost less in many instances; there is no trouble about it. The water in the boiler might be objected to; in this case it is a matter for the scientific engineer to explain the proper curvature that would be safe. There is no trouble in going up again, as already explained.

The engineer must necessarily take soundings of rivers before he can build a bridge. These soundings would do for a tunnel with the proper allowance below the river bottom for the top of the tunnel. They might go down to a point of safety; all would depend upon the nature of the bottom, and care should be taken that the approaches should be placed above high-water mark.

If this plan were adopted, instead of high trestling, partaking of the balloon, and engineers of prominence were to act upon it, a great saving and any amount of good could be done.

I learned my profession in England; it was the Brunel school—the man who built the tunnel under the Thames—it was looked upon as wild and visionary.

I hope, sir, you will give these ideas a place in your valuable journal, and send me a copy, to the office of the N. P. R. R., in this city.

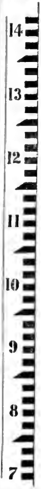
John Doherty, C. E.

THE METRIC SYSTEM.

Engineer's Office, Mexican Central R. R.,
Guanajuato, Mexico, Feb. 16, 1882.

Editor Engineering News:

I desire to be placed on the record as advocating 20 meters as the length of the standard metric chain.



In my communication which appeared in your issue of Jan. 7 I merely gave what is the practice on one of the Mexican railways, for the information of your readers. In fact, in an article published some two and a half years ago in your paper, I strongly and urgently advocated 20 meters as the proper length, and for reasons not necessary to repeat here. Since then I have had considerable practical experience with the metric system, and so have no occasion to change my opinion in regard to the length. In the same issue (Jan. 7) appeared a communication from Mr. Bradford, in which he takes numerous exceptions to the metric system when applied to railroad work. It is certainly not the fault of the metric system when the application of the same is not properly made, as witness the adoption of the 25-meter chain.

The same objection could logically be brought to bear upon the foot system if the chain of that system consisted of 75 ft. instead of 100 as at present.

But with a 20-meter chain I cannot conceive why it should be more difficult to do "curve work" than with a chain 100 ft. long. It is as readily divided into halves and quarters without the use of more than one figure, and this length (20 m.) is also divisible by 5 and 10.

The objection to the level rod is also without foundation. The difficulty in readily determining the meters is wholly overcome by marking the meter in connection with the decimeters, that is to say, to mark the decimeters continuously from end to end instead of beginning anew with each meter. I have had several level rods made and marked in this manner, and with *ordinary* care it is impossible to make errors.

The rods are three meters long (and of course can be made longer if necessary or deemed advisable) and 5 centimeters wide and 2½ centimeters thick. They are divided into centimeters, being alternately white and black, and extending 2 centimeters across the face of the rod (from the edge), thus leaving 3 centimeters for the figures.

The accompanying sketch will show the arrangement more readily than any extended description.

Emile Low.

SIZES OF SEWERS.

Editor Engineering News:

Dear Sir: Can you give me any satisfactory formula for proportioning the sizes of sewers, when inclination and area are given? Have figured by Hawksley's formula, also by Roe, and there is a large difference. Figuring by Hawksley, and then figuring the amount of water to be taken per hour, I find that it does not agree at all with the size required to carry away the water.

S. C. T.

[In populous districts, and when the main sewer receives contributions at constant intervals throughout its length, and the rainfall is estimated at one inch per hour, Hawksley's formula is a safe one. Roe's tables, for he gives no formula, are entirely unreliable, and in England are not regarded as having any basis beyond an hypothesis of Mr. Roe. We would recommend, as in accordance with much experience, that when the rainfall is of very variable extent, the formula of Mr. Hering, given in Engineering News of Jan. 28, 1882, would be a safe guide. This will give the volume of water in cubic feet per second, and this applied in any of the established formulæ for water drainage, such as Downing or Beardmore, will give the diameter of a circular sewer capable of discharging that quantity.]

METRIC LEVELING RODS.

Boston, Feb. 27, 1882.

Editor Engineering News:

The great variety of designs that have been used for self-reading rods divided into feet and hundredths is almost entirely due to the diminutive size of the divisions of the foot. Even at moderate distances they cease to be easily distinguishable, and to adapt the rod to long distances recourse is had to various groupings of lines, and to the size, shape and position of numerical figures. These features, being entirely arbitrary, have led to the production of a great variety of combinations, no one of which has been extensively adopted.

The divisions of the meter being more than three times as large as the corresponding divisions of the foot, a metric leveling rod can be read at much greater distances. Their efficiency is, therefore, much less dependent upon any peculiar grouping of lines, or the position or shape of numerical figures, and a design based upon a few general principles will be more extensively adopted.

The variety of designs will consequently be less, and the makers of engineering instruments will take more interest in perfecting an article which promises a better demand.

An acceptable design for a metric leveling rod must be decimal in character, and must be based upon a consideration of the absolute size of the divisions of the meter and their adaptability to various classes of work. It should provide the assistance needed by the eye in counting its finer divisions, and its figures should be of sufficient size to be easily read at a distance.

According to the well-known principle that an approximate measurement, taken to the nearest unit, will not differ from an accurate measurement by more than one-half that unit, we may premise: Firstly, that approximate readings of the rod taken to the nearest *decimeter* will vary five centimeters, or less, from accurate readings. This degree of approximation is within the limit of accuracy required in preliminary surveys and reconnaissances, benches and turning-points excepted.

Secondly, that approximate readings taken to the nearest *centimeter*, will vary five millimeters, or less, from accurate ones. Such readings are, therefore, suitable for a very large portion of engineering work.

Thirdly, that readings taken to the nearest *millimeter* will be within half a millimeter of the greatest possible accuracy.

Now it may be easily ascertained by trial, that the unavoidable errors of observation incident to the process of leveling are at least of the same order of magnitude as the half-millimeter. They arise from the difficulty of maintaining the line of collimation strictly level during an observation, from the space covered by the thickness of the cross-hair, from imperceptible deviations of the rod from the vertical, and from various other causes. Readings taken to the nearest millimeter are, therefore, within the limits of accuracy attainable, and an attempt to work to fractions of the millimeter would be an unnecessary refinement.

A leveling rod suitable for all classes of work should, therefore, be distinctly marked in *decimeters* and *centimeters*.

Divisions into millimeters are not attempted on self-reading rods. Target rods, however, are provided with a short scale of millimeters, which takes the place of a vernier.

The millimeters are read from a self-reading rod by a mental subdivision of the centimeter blocks into ten equal parts. This may be done with surprising accuracy, and offers no special difficulty when the process of reasoning upon which it is based is well understood.

A division into ten equal parts admits of but five different combinations, viz., 1 and 9, 2 and 8, 3 and 7, 4 and 6, 5 and 5. If the cross hair falls near the end of the block it is called 1 or 9. If it cuts off a little less than one-fourth it is called 2 or 8. If it cuts off a little more than one-fourth it is called 3 or 7. If it is nearly in the middle it may be either 4 or 6; if exactly in the middle, 5. The number of cases being so very few a little practice will enable one to estimate tenths with great accuracy.

To assist the eye in counting the centimeters every fifth one should be distinctly marked to form a new point of departure.

The divisions may be painted in black or in vermilion, upon a white ground; or alternate meters may be in black and red. Black divisions form the strongest contrast for the white ground. Red divisions throw the cross-hair into stronger relief and are more easily seen among foliage. The figures should be black, invariably, with broad lines, hair lines being avoided. They should be at least 25 millimeters in height.

The figures indicating the meters should be repeated at every decimeter, forming, with the other figures, a continuous numbering in decimeters.

A rod thus marked will always present to the

(Continued on Page 92.)

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Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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APPLIED MATHEMATICS.

In answer to a correspondent on the subject of the radius of gyration in another department of this issue, we take occasion to express our satisfaction at the opportunity which it offered of giving some hints to young America on the tendency of the "would-be scientist" to run riot in mathematical symbols, on the erroneous impression, that science consisted in "burying the most simple facts completely out of sight under heaps of mathematical rubbish." We are indebted for this last expression to an accomplished and well-known engineer, who, endeavoring to render his past experience of value to those who come after him, finds the necessity at times of dredging into this rubbish, and bringing to the light of day what of truth may lie hidden at the bottom.

On the other hand, we would deprecate as fraught with untold evil, the least of which is tha money value wasted, the practice of engineering by individuals ignorant of tha very foundation upon which all engineering science must rest—viz., mathematical truths; and we would particularly warn our young friends against adopting the views of the manager of the Hudson River Tunnel as shown in his testimony before the Coroner's jury, which we reprinted in our last issue under the head of "RULE-OF-THUMB ENGINEERING." And we note this instance with a view to impress upon our readers the distinction which we would draw between the *misuse* of the higher analysis in its application to every-day mechanical details, and the proper *use* of those mathematical principles which form the basis of all engineering operations.

In the preface to Prof. Rankine's "Applied Mechanics" (third edition), a writer who confessedly indulges in more "tangled" and needless exhibitions of elementary analysis of plain, practical, common-sense problems than almost any writer on mechanical subjects with which we are acquainted, yet expresses himself as follows, after referring to the importance at times of complex algebraical investigations: "But in expounding a proposition as a part of practical science, and applying it to practical purposes, simplicity is of the first importance; and in fact, the more thoroughly a scientific man has studied the higher mathematics, the more fully does he become aware of this truth, and I may add, the better qualified does he become to free the exposition and application of scientific principles from mathematical intricacy."

Notwithstanding this very sensible annunciation in favor of simplicity, it has never been our pleasure to see anything of Professor Rankine's which was not more or less obscured by a jugglery of mathematical symbols, wholly uncalled for by the nature of the subject treated, and tending to complicate what in itself was sufficiently simple. And in an acquaintance with engineers, who all speak of Rankine with respect, we rarely have met one who was ready to acknowledge that he has derived any practical advantage whatever from his method of investigations. And in our experience of nearly half a century as an engineer we have very rarely found that engineers possessing this peculiar facility of minute mathematical analysis with the consequent reliance upon its infallibility which usually accompanies it, were safe guides, either in the design or the execution of novel projects.

Recognizing Rankine as a master of analysis, weak minds have been led through his example, and as an evidence of scientific ability on their own part, to confound facility for putting into complex mathematical relations facts and figures with methods which readily admit of simpler treatment.

Now, the higher analysis is an exact science, and were the concrete matters dealt with in applied mechanics equally exact or certain in their values, there would be no objection to this method; but we are dealing practically with imperfect materials; how imperfect, and in what direction, we know not precisely, but after pursuing the methods of the calculus based upon presumed homogeneousness of material, the fallacy of the process for practical purposes is recognized, and varying coefficients and factors of safety, according to the judgment of the engineer, are finally of necessity introduced, in order to render the result of any practical value. Hence the absurdity of looking in the clouds with a telescope of high power in search of facts within our grasp on the surface of tha earth.

As an illustration, having had occasion lately to investigate the subject of high masonry dams, we turned to one of Van Nostrand's science series treating of the subject for such light as might be had, and after following several pages of elaborate calculation in which all the resources of the calculus were exhausted, and which undoubtedly exhibit the author's mathematical skill, whatever may be said of his judgment, we finally, in search of the proper profile of the dam, arrive at two equations, of which the author remarks as follows: "Here a new difficulty presents itself, for no sooner do we attempt to integrate equations 34 and 35 than we see it is quite impossible to perform the integration by any exact method." Attempting the solution, however, by a method of approximation credited to Mr. Delocre, he arrives at two equations, of which he remarks: "These equations, it is quite apparent, are of no earthly value for practical purposes, and we shall drop all further consideration of them," and adds: "Indeed, if it were possible to obtain the equations of the curve by a short and simple process of integration, a moment's reflection will show that such a profile would not be suitable for practical use." Continuing our search for truth, we found that Mr. Delocre had written an exhaustive treatise on the subject of high dams in a memoir published in the "Annales des Ponts et Chaussées de 1866," and referred to in the "Manuel de l'Ingenieur des Ponts et Chaussées," by A. A. Beauve, translated by E. Sherman Gould, Assistant Engineer Croton Aqueduct, New York, in the following words: "There is no difficulty in establishing the differential equations of the resistance of reservoir dams, but their integration has not been effected; they therefore possess no practical interest. They may be found in the work of M. Delocre," and finally recommends as of more practical value a calculation based upon graphical construction. Now it would appear from the above that, seeking a result founded upon abstract truths, it was not until the calculation was complete that it was discovered that after exhausting the powers of the calculus ineffectively, recourse was finally to be had of necessity to a simpler method before a tangible result could be reached. If the teachers of applied mathematics would but follow Professor Rankine's advice as given above, and not his practice, we would not be disposed to question their skill as teachers, but the pursuit of abstract, pure mathematics as an end in itself is so seductive that its legitimate application toward enlightening the many is too frequently lost sight of by its admirers.

Now it would be absured to question the value of the differential and integral calculus, for as one of its historians remarks, alluding to the kindred methods of fluxions, "it is one of the greatest, most subtle and sublime discoveries of this or perhaps of any age, opening a new world to us, and extending our knowledge, as it were, to infinity, and carrying us beyond the bounds that seemed to have been prescribed to the human mind."

While there are some problems of practical value, the solution of which cannot be reached but by the use of the calculus, there are many others where the claim to mathematical accuracy growing out of the mere use of this method, irrespective of the data upon which it may have operated, is a pure assumption and a confounding of mathematical adroitness in the compilation and transformation of formula with science. Mathematics is merely the symbolic language, so to speak, through which the truths of science in their relations, one to the other, may be expressed.

For instance, operating by the established mathematical rules upon imperfect or false data, however skillfully conducted the process may be so far as the mathematician is concerned, the result is not science, although the process may be what is called scientific.

The whole gist of this question of misapplied mathematical skill is well shown in one of "Prof. Huxley's lay sermons," and we beg leave to commend its perusal to our would-be mathematical scientists.

"Mathematics," he says, "may be compared to a mill of exquisite workmanship which grinds you stuff of any degree of fineness; but, nevertheless, what you get out depends upon what you put in; and as the grandest mill in the world will not extract wheat flour from peascods, so pages of formula will not get a definite result out of loose data." We are well aware of the kind of criticism to which we lay ourselves open by questioning the universal applicability of the integral calculus, viz.: "That we are probably completely ignorant of its uses." Two years, at least, of our student life was expended in its study under the instruction of a mathematical teacher and author. Whatever may have been our progress, so soon as the applied mathematics came within our daily professional practice, we found so slight a need for the exercise of the calculus that its continued disuse left little in our memory beyond its nomenclature. The differential calculus is that branch of analysis whose object is to determine the limit of the ratio of the increment of any function to the increment of the variable; the term function of a variable being applicable to any quantity dependent upon that variable for its value. The integral calculus, on the contrary, has for its object the determination of the primitive function, from which a given differential expression has been derived. Together, they constitute what we call the calculus, well suited to exercise the analytical faculty of mathematical students; and something more than its elements, merely, should be mastered by all teachers and professors of mathematics and theoretical engineering; but its continued study in practical life (and without this study its proper use is impossible) is not conducive to the successful practice of engineering, save in rare instances for reasons previously hinted at.

The doctrine of fluxions, in use from the time of Newton, and which differs from the more modern differential calculus, but in its nomenclature (a fluent being the same as the function in the calculus, and a fluxion the equivalent of its differential coefficient) was referred to by Tredgold in the preface of his treatise on cast iron, republished by Hodgkinson in 1842. Tredgold was a writer of eminence on many branches of physics, and exhibited very high mathematical attainments in the demonstration of his various investigations, and was never open to the charge of ignorance of any subject whereof he wrote. While we cannot say that we carry our objections to the use of the calculus in applied mathematics to the same extent as this writer has done we doubt not that the reliance which we have been taught to place on his writings shaped themselves into an assent at least to the non-essential value of the calculus to the practical engineer.

We close with a quotation from the preface referred to:

"I have avoided fluxions in the investigation of these rules in consequence of the very obscure manner in which its principles have been explained by the writers I have consulted on the subject. I cannot reconcile the idea of one of the terms of a proportion vanishing for the purpose of obtaining a correct result. It is not, it cannot be good reasoning, though, from other principles, I am aware that the conclusions attained are accurate. If the doctrine of fluxions be freed from the obscure terms, limiting ratios, evanescent increments and decrements, etc., it is really not difficult. If you represent the increase of a variable quantity by a progression, any term of that progression (except the last) corresponds with what is called a fluxion; and the sum of the progression is the same as a fluent. A fluxion is, therefore, the velocity of increase of an increasing quantity, a decrease of a decreasing one, on the supposition that we take the velocity at any point and consider it uniform. But when you use this uniform velocity to represent an accelerated one and say that the ratio of these velocities approaches to a ratio of equality as its limit, while the space or time of description is diminishing to evanescence, I must be allowed to withhold my assent to your doctrine. For it is clear that the exact ratio of equality can attain only when the space described is nothing, and consequently it cannot, with logical accuracy, be employed to compare the spaces generated when they become of finite magnitude."

THE OUTLOOK FOR ENGINEERS.

The careful attention of those engineers and contractors who are placing their main hopes for employment during the coming season, on railroad building is invited to the reported interview with Mr. Russell Sage, one of the leading railway magnates of the country, which will be found in another column of this week's Engineering News. Mr. Sage asserts that there will be a great falling off in railway construction this year, and the activity of the past two years may perhaps not be resumed for some time to come. Mr. Sage is one of the leading speculators in Wall street, a region that hatches more unreliable information than perhaps any other spot of equal area in the habitable world, and so whatever Mr. Sage says on matters that deal directly with the rise and fall of stocks may naturally be received with some grains of allowance for the influences surrounding him. But it is probable that he tells enough truth to warrant the thoughtful consideration of those men who are patiently awaiting the time when active operations in railroading will be resumed, and who if warned in time would turn their attention elsewhere to their own advantage and to that of those who cannot change at once without very serious damage. By thinning the ranks of competition fair profits may continue to be made, while those who enter other fields will not suffer. But where shall the "left" ones look for business? First, if it could be succesfully accomplished, the "incompetents" should be weeded out, and obliged to go into other and, probably, more profitable occupations; if any that remain are tempted to try land surveying, we advise them to abandon such an evidence of mild insanity, and turn their muscle, if not their brains, to more profit; in the larger cities the Engineering department is usually well stocked, and the politicians keep faithful watch and ward over it, lest perchance an occasional vacancy should occur; do not waste time and energy upon such well tilled ground. We confess we hardly know where to point the way to aspiring engineers, except they are themselves prepared to do considerable original investigating, and if necessary, "tramp" it in search of opportunities. Foreign engineers, notably the English, are the promoters of nearly all public works; they do the "prospecting," discover the opportunity, "work up" the scheme, form the constructing companies, and with the aid of the solicitors, carry the scheme through the necessary legislation, and then, if further progress is deemed advisable they construct the works. But we never hear of an American engineer "promoting" any public work. Instead, it is done by some shrewd man who sees, or fancies he does, "millions in it," and all the part the engineer plays in the scheme is to make a few surveys at so much per diem to get data to work from, and then if the matter succeeds he gets possibly a few months' further employment at the lowest price his services can be engaged for. If there is profit in the venture he fingers no portion of it, and in a few months he is forgotten, until, perchance, his former patrons may have discovered something else for which they need the use of his brains and skill for another short while. From this plan of professional action scarcely any notably prominent engineers arise as may be found in England, where large incomes are enjoyed by a great many engineers, some of whom have world-wide reputations, and have won their way to special distinction by their sovereign. This country never was in a more prosperous condition than at present; money abounds, and, as a usual thing, the people are not afraid to spend it. There are States in the North, like Vermont and New Hampshire, where agriculture being the leading industry, and the principle of being careful of the small change having permeated the whole body politic, there are no large public works likely to be undertaken, and it is but a waste of railway fares and hotel bills to journey in that direction. Only native born and bred engineers can hope for even a small measure of success thereabouts. Again, in the South there is a remarkable dearth of large towns and cities; money is not as abundant as is desirable, and while the conditions are yearly growing more favorable, our engineer must pay out a "good bit" in traveling expenses, and subject his stomach to a very severe course of dieting before he will find an eligible location to practice his profession in with profit. But there *are* opportunities in the Southern States that will repay the investment of time and money and brains necessary to develop them. It is a magnificent country and it is inevitable that it must make very great progress within the next decade. But there are hundreds of considerable towns demanding better water supply and sewerage and paving, and for the engineers who will go to the expense and labor of "prospecting" for them we are quite certain that a large and profitable field awaits their cultivation. There is also more bridge building to be done at present than there are companies to do the work, and whatever may be said about competition and low prices, it is noteworthy that there are very few financial failures in the bridge-building business. There is a vast area of country between the Atlantic and Pacific to be developed and improved for the use of its ever and rapidly-growing population, and while there may be temporary lulls in engineering activity, yet there must always be a fair proportion of remunerative business for the men who are alert and who care to keep sufficiently posted as to the shifting scenes of activity in their profession. But we feel convinced that a considerable advance will be made when engineers assume the leadership in promoting public work, instead of simply "sitting in the market-place" like common laborers "waiting for a job."

SPIRAL CURVES.

We would not discourage the study of such subjects as comprise the contribution under the above heading in No. 10 of Engineering News. The writer has treated it with ability, and shown a painstaking desire to perform accurate work, and we should have spared any question of its practical value had it been a mere office exercise; but from the statement that "on the road 30 meter spirals are being laid out by locating parties as well as for track centers," it appears that the engineer is muddling the heads of his assistants with refinements of location, when their time could better be employed in some study of practical value to them in their future career. We venture to say that laying off such a curve as he has illustrated from one tangent point, with such instruments as are to be found on most railroads, and then laying off the same curve from the other tangent point, there could be no possible agreement between the points made unless by a system of repetition and some elimination, which means loss of time and patience on the part of operatives. If this were attended with a possible benefit, it would be well, but let us assure "Young America" that it has no practical value whatever, and tends to bring into discredit much of his labor which is of positive value. It is desirable, it is true, to connect the tangents on a line of road, by curves of as long radius as the location and nature of the ground will permit for mechanical reasons in the nature of the machinery used, and it is also desirable to reduce the shock occasioned by passing at high speed from a tangent to a curve to a minimum. But within limits the expenditure of power at a given speed in a change of direction of a certain number of degrees of arc is the same whatever may be the radius of curvature. If there were in nature some principle by which bodies tended to move in curves, this might possibly be otherwise, but as things are the curved motion is the resultant of forces tending to move in straight lines, and practically no body in motion on a railroad track is *coaxed* into a total change of direction with the expenditure of less power by gradually increasing the increments of change from a minimum to the maximum.

We have ourselves been in this same boat. In the "Curve of Construction," written by Sganzin, "Inspector Général des Ponts et Chausées," the text-book of many years ago, it is recommended that changes of directions of roads should be made by parabolic curves, and gives as a reason, that "the extent of curvature of such curves decreases as we pass from the summit of the curve, and consequently the passage from the straight line to the curve is less sensibly felt." We have here the principle of the spiral curve, as we understand it. Full of the importance of the labor, we laid off such curves, not on location lines, but in laying the track. Revisiting the locality some years afterwards, we found, as might have been expected, that what with settlement of road-bed by effect of frost and otherwise; the track repairers had wholly disregarded our refinements of line, and laughed, as they well might, at parabolic curves. This easement at the point of tangency, as it is called, as also between adverse grades by vertical curves, can well be left, where it always will be exercised, to the eye of the skillful track-man, with his straight-edge and crow-bar.

PERSONAL.

Mr. Thomas H. Tracy has been appointed City Engineer of London, Ont.

Thomas Hanford Smith, who died suddenly of apoplexy on the 16th, at his residence, 448 West Twenty-second street, this city, was the builder of the Boston Cathedral, St. James' Church, Boston; the West Twenty-third Street Presbyterian Church, the Madison Avenue Reformed Episcopal Church, the Metropolitan Life Insurance Company's building, the Foundling Hospital in Sixty-seventh street, and the New York Bar Association's building. He was born in Rye in 1812, and had been in business in this city 48 years.

Mr. Norman Stratton, civil engineer, United States Navy, died suddenly of heart disease on the 10th at his residence No. 242 DeKalb avenue, Brooklyn, in his sixty-third year. Mr. Stratton was born in Stillwater, Saratoga County, this State, graduated from the Rensselaer Polytechnic Institute, Troy, and subsequently from the Albany Law School. He was civil engineer of the first railroad constructed from Albany to Schenectady. He afterward practiced law in this city for 17 years. About 11 years ago he was appointed civil engineer in the United States navy. In 1878 he was run over and seriously injured by a carriage. His health subsequently failed, and last fall his name was placed on the retired list.

RECENT INVENTIONS.

A novel ditching machine or excavator has an inclined auger secured within the frame or body of the machine for excavating and elevating the earth, the cutting edges of which turn in a semicircular groove formed in a block attached to the under side of said frame. The arrangement of this groove is such as to cause the excavated earth to rise to the outlet, whence it falls on stationary inclined planes, that direct it to the sides of the ditch.

Another late invention in excavators has an excavating wheel which turns in a vertically-adjustable swinging frame journaled on the engine driving shaft, and is driven by a chain from such driving shaft, which operates a pinion meshing with an internal gear on the wheel. An inclined shelf and vertically-adjustable shield are carried by the frame, whereby the dirt is directed to one side, and prevented from falling from the buckets while being elevated. The machine is fed forward through a sprocket wheel and chain driven from the engine, and is capable of being worked with or independent of the wheel-driving mechanism. Stationary side plates protect the internal gear.

An interesting improvement in bridge gates for draw-bridges consists in operating the gates at either end of the draw, by pneumatic pressure controlled by the bridge attendant through suitable mechanism on the draw-bridge. The gates slide in vertical guides on the abutments, and air cylinders, with tight-working pistons connecting with the gates, are located in the abutments beneath the gates. On the pier upon which the draw span revolves are arranged suitable air-compressing mechanism, having pipes leading therefrom, along the bed of the channel to the before-mentioned operating air-cylinders.

A late improvement in steam boilers combines with the grate and hollow side walls of such boiler a series of side pipes for conveying the products of combustion, and a series of steam pipes communicating with such side pipes, at or near the discharge orifices, whereby the products of combustion are drawn back and discharged into the fire.

A novel stock or cattle car has a feed bin arranged beneath the roof of the car, and extending the length thereof. This feed bin has its bottom wall constructed with openings, governed by valves adapted to be simultaneously operated. Adjustable troughs are suspended beneath said bins adapted to be secured at any desired elevation. A water tank is also located on the roof of the car with pipes leading throughout the car to suitable drinking receptacles. The pipes have appropriate stop-cocks.

A new dredge-dipper consists of a two-part dipper-bottom, the lower front section being secured by an adjustable catch, and pivoted to the opposite sides of the dipper. The other or top section is capable of swinging in as well as out, and when loaded rests against the upper edge of the lower section. The arms of the bottom section are pivoted to raised seats upon the side straps, to which are secured handle-braces. This improvement is designed for use in connection with a steam-dredging apparatus.

A late invention consists of an electric meter comprising a clock work mechanism having an escapement governed by a pendulum or balance of magnetic metal, in connection with an electro-magnet, the poles of which are arranged to determine the movements or oscillations of the pendulum or balance. This magnet is arranged in the electrical circuit, through which the current is to be measured.

A novel apparatus for superheating steam, designed particularly for locomotive boilers, consists of the steam pipe, which is arranged to pass through the roof of the fire-box, extending horizontally therein, and thence repassing through the roof of said fire-box and connecting with the cylinders of the engine. A tube incloses that part of the steam-pipe located within the fire-box to create an intervening water space between the two, said tube having its ends secured in the roof of the fire-box, and in communication with the water space of the steam boiler.

F. B. Brock.

Washington, D. C.

THE CHECK TO RAILROAD BUILDING.

When asked for his opinion of the present condition of railroad business and the prospects of the companies, Russell Sage said to a reporter:

"The present inability of promoters of railroad enterprises to go on, being checked by their failure to negotiate bonds and stocks to secure the money to prosecute the work of construction, leaves the older and already finished roads in a better condition than would be possible if the mania for building new roads were to continue."

"Then you consider the construction of new roads practically at a standstill for the present?"

"Few railroads will be built this year. There is a general suspension of this work all over the country. I am connected with a dozen of these corporations, and in each instance we have wound up the work for the present, after settling with the different contractors. I do not think they will go on again for a year or two; perhaps it will be even longer. I am ready to go on when I am satisfied that it will pay; but I am unalterably opposed to building a mile of railroad when the business will not fully justify it. There is an unerring law of progress, that fully one-half of all the new railroad enterprises are swept away, and another set of proprietors comes in to take their places. The history of three-fourths of the roads built in the United States shows that the original promoters of new roads have to sell out for one-half, or less, of their investment. A necessary result of the present suspension in the construction of new roads will be that investors will take the stocks of the finished and already paying roads at better prices than have recently prevailed."

"To what causes do you attribute the recent downward tendency of all railroad stocks?"

"It is well known that we had a pretty full head of speculative steam on previous to the assassination of President Garfield last July. That caused the first check. From the 2d of July on, down to the beginning of the present year, there has been a steady decline, with the usual fluctuations. These fluctuations have been owing, in part, to over speculation and over construction of new railroads; the general decline was accelerated by the short crops and damaging freshets beginning early in October, running through that month and November. When we reached the beginning of the new year, financial troubles broke out in France and spread all over Europe. The rates of interest rose from 2½ to 8 and 10 per cent., which was very excessive for such old and conservative countries as France, England, Austria, Germany and Holland, the money centres of the world. Of course, in that panic heavy losses followed, and enormous damage was done. These troubles in Europe contributed to our depression by sending back a good many of our stocks and bonds and throwing them on our market at a time when there was a decreased demand. The bears took advantage of this state of affairs to magnify and misrepresent the real condition of the country."

"How do you regard the improved tone of the market within the last few days?" asked the reporter.

"The country at large is very rich, and investors are well able to take securities at the lower rates which are now ruling. I regard the condition of things as assuming a very healthy outlook for the future. Prices are such as now to justify the most conservative capitalist in making investments. Money is plenty and the continual paying off of the National debt throws an almost unprecedented amount of additional money into the market to be invested. The recent change of tone on the street will do a vast amount of good to people who, having originated wholesome enterprises, will now be enabled to go on. This change of tone will be more beneficial to the business interests than anything that could have happened. Otherwise many legitimate and desirable enterprises must have suspended, owing to fear that we were drifting toward—not a panic—but general dullness and depression. I think that Mr. Gould and Mr. Vanderbilt, in coming forward and planting themselves down solid for the right, have restored a feeling of confidence which was very much needed, and which will produce very beneficial results. With such crops as we may reasonably expect, and with the unexampled prosperity of the past ten years going steadily on, I shall be surprised if by September and October a general change of such a character is not shown as to prove how the wicked 'bears' have misled the public in trying to make it believe that ruin was close at hand.

"Another view to be taken of this depression, and one which makes it clear that it has not been without profit, is that it has checked extravagance and the growing importation of high-priced luxuries from abroad. The importation of these goods has materially fallen off, much to the gratification of thoughtful people who watch the balance of trade, which should continue in our favor. In view of all these facts, I am strengthened in the conviction that we have turned the corner in this downward career of the market, and that from this time on the advance will be continuous on all completed roads that deserve it."

ENGINEERS' SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, No. 1523 CHESTNUT ST.,
PHILADELPHIA, Pa.

Record of Regular Meeting, March 4, 1882.

President Rudolph Hering in the Chair. Twenty-five members and one visitor present.

The Secretary presented, on behalf of Mr. Thos. U. Walter, Honorary Member, a description of his experiments in 1836–7, upon the effect of extreme temperatures upon iron bands imbedded in the walls of Girard College, Philadelphia, of which he was the architect. These bands, each 54 ft. long, were introduced to resist the lateral pressure of the arches. Although confident that no evil could result therefrom, Mr. Walter considered the positive evidence of these experiments both satisfactory and interesting. The south vestibule wall, 5 ft. 5 in. thick, subjected to the full power of the sun during summer and in winter under temporary roof, with no fires in furnaces, was selected for experiment. Self registering thermometers, minimum for winter and maximum for summer experiment, were placed upon the band and the whole walled in as finished work. The following changes in Fahrenheit degrees took place:

Sept. 23, 1836. } 82°. { Intermediate extreme cold—3°.
July 29, 1837. } { Minimum temperature in middle of wall, 42°.
Jan. 16, 1837. } 24°. { Intermediate extreme heat, 94°.
Dec. 10, 1837. } { Maximum temperature in middle of wall, 61°.

Difference of temperature outside of wall, 97°.
Difference of temperature in middle of wall, 19°.

Smeaton's co-efficient of expansion for malleable iron, $\frac{1}{794}$ of length for 180°, being somewhat greater than that of other experimenters, was used. The co-efficient for brickwork, [illegible] of length for 180°, was taken from experiments by A. J. Adie, C. E., (Royal Society of Edinburgh, April 20, 1835).

The difference occasioned by a change of 19° in temperature in a length of 54' is, therefore, less than $\frac{1}{8}$", but if we consider that the exterior of the wall is subjected to the extremes of heat and cold, it will be obvious that the aggregate change of the brickwork is even greater than that of the iron.

Mr. Geo. P. Bland read a paper upon the practical strength of wrought-iron columns, giving formula and diagram, and arguing that the factor of safety should be established with reference to the limit of elasticity.

Mr. Howard Constable exhibited a blue copy of the Kinzua Viaduct, and stated that its height will be 300' and length 2,000'.

Mr. Henry G. Morris described the Hotchkiss mechanical boiler cleaner, which consists of a spherical cast-iron vessel placed above the boiler, which it enters by a vertical flow pipe bent 90° just below low-water line and opening there in funnel form; also by a return pipe carried nearly to the bottom of the boiler. The sediment, rising invariably to the surface before being deposited on the bottom or flues, is carried into the funnel by the circulation of the water from front to rear of boiler, and reaches the spherical vessel, where it is deposited; the water returning to the boiler by natural circulation. The sediment is removed from the cleaner by opening the valve in a pipe connected with the bottom thereof, after closing the valves in the flow and return pipes.

The Secretary presented a paper by Mr. P. H. Baermann upon "What thickness of metal should be given to cast-iron pipes under pressure?" The various formulæ are reduced to the same notation, classified and compared, and illustrated by numerous diagrams. The quality of iron, practical difficulties in casting, minimum strength required for handling, the static head, force of ram and of rapid closing of gates or hydrants and allowance for deterioration, are considered at length. A table of one-fifth ultimate strengths is given. One of the main facts derived from the comparison is, that the thicknesses, obtained from the formulæ, give pipes of varying strength when calculated for a given head, and that the least thickness, necessary to cover imperfections in casting and for safe handling, is ample for pipes of small diameters under all ordinary heads.

HOWARD MURPHY,
Secretary and Treasurer.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 127 EAST TWENTY-THIRD STREET, NEW YORK.

March 15, 1882.—The Society met at 8 p. m., President Ashbel Welch in the chair.

The death of Gen. W. W. Wright, member of the Society, in Philadelphia, March 9, 1882, was announced.

A paper by Mr. E. H. Keating, City Engineer of Halifax, was read by the Secretary. The paper described the results of the mechanical removal of incrustations from the water pipes of that city.

These incrustations had become so serious as to reduce the pressure so that in many places water would not flow from the street hydrants. In some pipes the deposit was over 1¼ in. in thickness. Six-in. pipes were found reduced to an internal diameter of 3½ in. to 3¼ in.

In the years 1875 and 1876 a number of miles of old 8-in. pipes were cleaned by a scraper attached to iron rods and propelled by hand. The scraper had 4 arms or knives attached to a center, and sprung outward by a thick rubber disk. This method was not practically applicable to pipes of large diameter; but in 1880 over a mile of 12-in. pipe was cleaned by a scraper forced through the whole length by the head of water in the pipe. This scraper was one imported from Scotland, and its work was fairly successful.

In 1881 the author of the paper constructed new scraping machines which differed from the others in having additional springs for the cutters and the pistons. These scrapers consist of an iron rod to which are attached two pistons and two sets of cutting tools, one in front of the other. The cutters are each made up of four strips of steel 2¼ in. broad, sloping backwards from the rod and at their outer termination shaped and sharpened like the barbs of an arrow. Thus they can yield when requisite and the cutting diameter can be altered by moving the steel strips. The pistons are of iron, lead and leather, to which Mr. Keating adds rubber springs. With this apparatus and with the ordinary head in the pipes about 12 miles of 24, 20, 15 and 12-in. pipes were cleaned at a total cost of $2\frac{7}{16}$ cents per foot. The results were remarkably satisfactory, as is shown by the fact that the average pressure on 25 hydrants on the wharves increased from $34\frac{7}{10}$ lbs. in February, 1880, to $52\frac{4}{5}$ lbs. in February, 1882. These were on the low service, the source of which is 4 miles from the city and 200 ft. above tide. On the high service, the source being 8 miles from the city and 360 ft. above tide, there is now a pressure of 19 lbs. per inch at hydrants where the water did not flow at all.

Some remarks were made on the overflow of the Mississippi River by Mr. Lyman Bridges, Member Am. Soc. C. E. The area of the water-shed of that river is 1,147,000 square miles, with an annual rainfall of 80,000,000,000,000 cubic feet and a drainage of 20,000,000,000,000 cubic feet. This is inclusive of the Red River basin. The principal levees are below the Red River. The mean annual amount of sediment passing the mouth of Red River is given by Humphreys and Abbott as 812,500,000,000 tons. The deposit of this at certain points is a source of constant danger. Levees are raised continually; but great floods, as at this time, frequently occur. The speaker suggested, as a measure of relief, the improvement of the old channel near the mouth of Red River, the improvement of the Atchafalaya and its parallel bayous, a connection with the Mississippi at Plaquemine, and the improvement of the outlet to Atchafalaya Bay. This would give a flood outlet one half the present length of the river from the mouth of Red River, and one-quarter the length from Plaquemine, through which 33 per cent. of the present flow could well be carried.

The necessity of complete surveys of the Mississippi were forcibly presented.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 84.

CCXXXIX.—NEW BRIGHTON, N. Y.

New Brighton, New York, in lat. 40° 38' N., long. 74° 1' W., is on Staten Island, on the shore of the Kill von Kull, on ground rising in terraces from the water's edge. It is occupied principally for suburban residences of persons doing business in New York City. Water-works were built in 1881, by John Lockwood, for a private company, W. J. McAlpine, C. E., being the consulting engineer. Water is taken from three 6-in. tubular wells, sunk 30 ft. in a sand and gravel stratum below the sea level, at the mouth of a ravine and small stream. A Knowles' compound condensing pumping engine, of 1,000,000 gallons capacity, lifts the water 210 ft. into a reservoir formed by a dam across a ravine.

Distribution is by 15 miles of cast iron pipe, of 10-in. to 4-in. diameter, with 150 fire hydrants, 46 gates and 250 taps. Ten meters are in use. Service pipes are of wrought iron—some plain and some galvanized. The town pays $40 per year each for hydrants.

The population accommodated is about 13,500, and the daily consumption is reported as 500,000 gallons.

The capital stock of the company is $200,000, and there is a bonded debt of $100,000 at 6 per cent. interest.

Further financial statistics are not furnished.

A. J. Hamilton is Secretary, and John Ward Superintendent.

CCXL.—POTTSTOWN.

Pottstown, Pennsylvania, in lat. 40° 15' N., long. 75° 85' W., is on the Schuylkill River, about 50 miles from its source. Settled in 1730, it was incorporated as a city in 1812.

Water-works were built by a private company in 1870 after the plans of Isaac S. Cassin, C. E., taking the supply from the Schuylkill, and pumping it by a Worthington pumping-engine into a reservoir 140 ft. above the river and 100 ft. above the town, with a capacity of 1,500,000 gallons at 17 ft. deep. Another pump is now building. Distribution is by cast-iron pipe of from 10 to 4-in. diameter, of which 7½ miles are laid, with 40 fire hydrants and 1,000 taps. A few meters are used. Service pipes are of lead. The City pays $500 per year for fire hydrants.

The population in 1880 was 7,214, and the daily consumption 135,000 gallons.

The capital stock of the company is $60,000. The works have cost to the present time $85,313.69. The bonded debt is $17,000. The expenses in 1880 were $3,971.78, and the receipts $7,451.23.

Mark H. Richards is President, and Joseph E. Yeager Superintendent of the Pottstown Gas & Water Company.

CCXLI.—WEST TROY.

West Troy, New York, in lat. 42° 45' N., long. 73° 37' W., is on the west bank of the Hudson River, on the bottom lands extending back nearly a mile to a slight elevation. The Watervliet U. S. Arsenal, established in 1807, is in the village, which was incorporated in 1836.

Water-works were built by a private company in 1876, after the plans and under the superintendence of Palmer H. Baerman, C. E., taking the supply from the Mohawk River, five miles from the village.

A dam 1,200 ft. long across the Mohawk gives a head of 7 ft., used for driving a 75-in. turbine wheel, which works a double-acting Flanders pump of 1,500,000 gallons capacity, which lifts the water 130 ft. to a chamber half a mile distant, whence it flows by gravity 5 miles to a reservoir built in excavation near the village and 180 ft. above it, and holding 70,000,000 gallons.

The force main and the conduit where crossing valleys are of 12-in. cast-iron pipe. The conduit, where laid on the hydraulic grade line, is a 15-in. oval cement pipe. Distribution is by wrought-iron and cement pipe, of which 12 miles are laid in West Troy. For the adjoining village of Green Island, which is supplied from these works, 3 miles of cast-iron pipe have been laid. The mains are from 16-in. to 4-in. diameter, and there are 90 fire hydrants and 350 taps. The village pays $10,000 per year for use of hydrants, with the right to require 100 to be set, in all. Lead and wrought-iron service pipes are used.

The capital stock of the company is $100,000. The bonded debt is $150,000 at 7 per cent. interest, and $20,000 at 6 per cent. The cost of the works has been $250,000. The expenses in 1881 were $18,000, including interest and taxes, and the receipts are reported as the same amount.

George P. Meneely is the President, and George M. Wiswall, Secretary, Treasurer and Superintendent.

CCXLII.—MELROSE.

Melrose, Massachusetts, in lat. 42° 27' N., long. 71° 4' W., is in a valley surrounded by hills. Settled about 1650, it was incorporated as a town in 1850. Water-works were built for the town in 1870 by George H. Norman. The supply is taken from Spot Pond, so named by Gov. Winthrop when he discovered it in 1632 and saw "divers small rocks standing up here and there in it." It covers 296 acres, drains 1.72 square miles, and is used also for supplying Medford and Malden. Its surface is 143 ft. above the village. A 16-in. wrought-iron and cement pipe conveys the water from the pond for 7,170 ft., and then is continued of 12-in. diameter for 893 ft. This pipe is owned jointly by Melrose and Malden.

Distribution is by 16.3 miles of 6-in., 4-in. and 2-in. pipe of wrought iron and cement, with 89 fire hydrants, 92 gates and 1,006 taps. Service pipes are of enameled iron. The town contributes from taxation $2,000 annually for fire hydrants and water used in public buildings and $1,500 for maintenance.

The population in 1880 was 4,443. The consumption is not known.

The works have cost for construction to Jan., 1882, $176,967.41. The total receipts from water rates from 1870 to 1882 have been $86,981.61. The bonded debt is $150,000 at 6 per cent. interest.

The expenses in 1881 were for maintenance $2,849.62 and for interest $9,000. The receipts were $14,549. The works are managed by three commissioners elected by the town. Addison Lane has been the Superintendent since 1871.

CCXLIII.—YORK.

York, Pennsylvania, in lat. 39° 58' N., long. 76° 43' W., is on both sides of Codorons Creek, in an undulating country. It was settled in 1720. Water-works were built by a private company in 1816, taking the supply from springs and conducting it into a small reservoir. Most of the supply is now taken from the creek and pumped 90 ft. into two reservoirs 15 ft. above the highest part of the town. The first pump was built by Birkinbine. A Worthington pump was put in later. Distribution is by 10 miles of cast-iron pipe of 10-in. to 2-in. diameter, with 50 fire hydrants, 34 gates and 1,500 taps. Service pipes are of lead. Water is furnished free for fire and public buildings. The population in 1880 was 13,940. The consumption is not stated.

The capital stock of the company was at first $10,500, which has been increased from time to time to $100,000. There is no debt. Further financial statements are not given.

Samuel Small is President of the Company and Jacob L. Kuehn the Superintendent.

CCXLIV.—LYONS, N. Y.

Lyons, New York, in lat. 43° 4' N.; long. 77° 8' Wis., on the Clyde River and Erie Canal.

It was settled early in the present century.

Water-works were built by M. V. B. Rowley in 1877 for three persons as a private enterprise, taking the supply from a large well fed by springs, and lifting it 20 ft., by a double force pump driven by a windmill, into a reservoir 1,200 ft. distant, holding 12,000 gallons and situated from 70 to 100 ft. above the village. Distribution is by 1½ miles of cast-iron pipe of from 6-in. to 2-in. diameter, with 100 taps. There are no fire hydrants, the supply being for domestic use only. Iron service pipes are used. The population is 4,200. The consumption is not known. The works cost $4,000. The receipts are about $400 annually.

M. V. B. Rowley is the Manager.

CCXLV.—ST. CHARLES.

St. Charles, Missouri, in lat. 38° 48' N., long. 90° 28' W., is on the Missouri River. The city extends along the river bank, the business portion being on a plateau about 15 ft. above high-water mark, and 400 to 500 ft. wide. Back of this the ground rises about 200 ft. in 1½ miles. The difference between high and low water is about 40 ft.

The town was settled about 1760 by the French. It was the capital of the State when admitted to the Union in 1821. Water-works were built in 1881, by Carroll E. Gray, for a private company, after plans of Charles A. Smith, C. E., and under superintendence of J. T. Jones, C. E. The supply is taken from the Missouri River. In mid-river there is an abrupt step-off in the rock bottom. On this, at 8 ft. below low water, a 12-in. perforated wrought-iron pipe is laid, continued for 200 ft. with a flanged wrought-iron pipe, and then for 600 ft. with cast-iron pipe to a pump well of masonry, 25 ft. square and 30 ft. deep from the surface of the bank. A Knowles Cornish pump, of 2,000,000 gallons capacity, the steam cylinder being at the top of well and the pump at the bottom, pumps the water into two plate-iron settling tanks, each 70 ft. in diameter and 15 ft. deep, set on a masonry bed, 80 by 160 ft. on the edge of the bank, 10 ft. above high water. The sediment from the tanks is run off into the river. The settled water is pumped by two Worthington duplex pumps of 1½ million gallons capacity each, into the distributing mains and a circular wooden tank, 20 ft. in diameter and 16 ft. high, set on a brick tower, 25 ft. square and 40 ft. high, on the hill back of the city. The water level in the tank is 318 ft. above low water in the river.

The tanks rests on timber-trussed beams, which are further supported by a timber trestle built in the centre of the tower, and not a part of the original design. All timber work is treated by the Thilmany process, and the brick-work treated with paraffine applied hot to the surface, which was dried by a portable furnace heating 2 ft. square at a time.

Distribution is by cast-iron pipe of 12-in. to 6-in. diameter. There are 7½ miles in use, with 40 fire hydrants and 200 taps. The city pays $100 each per year for fire hydrants.

The population in 1880 was 7,652. The works began operation in Dec., 1881.

The capital stock of the company is $80,000, and the bonded debt is $80,000 at 6 per cent. interest. The works have cost $80,000.

J. W. Ruenzie is the Superintendent.

(TO BE CONTINUED.)

CORRECTION.—March 11, 1882. Alphena, 6th line, for *fine timbers*, read *pine timbers*.

There are no water-works in the following towns included in list of Jan. 28: Northbridge, Mass.; Nebraska City, Neb.

The receipt of statistics as follows is acknowledged with thanks: From Daniel Walden, Superintendent, tenth annual report of the water-works of Lynn, Mass. From R. C. P. Coggeshall, Superintendent, twelfth annual report of the water-works of New Bedford, Mass. From B. E. Lehman, Superintendent, statistics and water rates of the water-works of South Bethlehem, Pa. From O. R. Fyler, Superintendent, statistics of the water-works of Torrington, Conn.

THE ENGLISH CHANNEL TUNNELS.

The channel tunnel, of which readers of the *World* have read so much recently, and which has made such a pother both in the press and in Parliament, may be said to be fairly under way. Indeed, according to a writer in the London *Daily News*, the so-called "experimental works" sanctioned by the government in 1875, have been pushed on so vigorously on the English side that three years and a far less amount of capital than the public supposes will see what was once looked upon as a visionary suggestion transformed into an accomplished fact. Two things only are required for this consummation—full Parliamentary sanction and the absence of any geological fault in the stratum in which the projectors are working. The entrance shaft to the experimental tunnel is sunk in the chalk cliff at the foot of the "Shakespeare Cliff," between Folkestone and Dover, and is about 150 ft. in depth. The opening is circular, with boarded sides. At the bottom of this shaft is a square chamber dug in the gray chalk, the sides of which are protected by heavy beams, and in front is the experimental boring, a low-roofed circular tunnel about 7 ft. in diameter, the floor in which is laid with a double line of tram rails. This tunnel is ventilated, and admirably ventilated, on the pumping system, and on visiting days is lighted with electric lamps, the steam power at the mouth of the shaft being sufficient for all purposes. The stratum through which the experimental borings have been made is the lower gray chalk, a substance that looks like "fuller's earth," and is nearly one-half clay and the other half chalk. This material, while perfectly water-tight, is not harder than tolerably hard cheese. The stuff taken out is easily converted into cement to line the walls of the tunnel when completed at its full diameter of 14 ft. About 100 yards a week have been excavated at present, or at the rate of 3 miles a year, and this quantity could probably be increased. Simultaneous borings from the French side at the same rate—always assuming that no fault is met with in the workings—would give 6 miles a year, or a complete tunnel underneath and across the channel in 3 years and a half. The experimental tunnel now reaches a length of two-thirds of a mile, at about 60 ft. below the level of low-water mark. The direction it takes from the English coast under the sea is toward the end of the Admiralty Pier at Dover and from here it will bend in a curve to the French coast opposite.

On the French coast the company who obtained a concession from the French government in 1875 to construct the southern half of the proposed channel tunnel have made considerable and, so far, satisfactory progress in the examination of the chalk cliffs near Calais, which are believed to be the outcrop of a continuous bed of homogeneous chalk running beneath the sea between the two shores. According to a writer in the London *Times* who visited the place a few days ago—Sangatte, about six miles from Calais—two shafts lined with brick and wood have been sunk. About 70 ft. beneath the surface the borers have found the *craie de Rouen*, a stratum corresponding to the lower portion of the homogeneous gray chalk which English geologists call the "chalk without flints." The lining is carried down to a depth of 204 ft., when the chalk becomes so dry and hard that a lining is no longer required. The depth of the shaft is about 280 ft., and a gallery 8 ft. high and of the same width opens into one of equal diameter running nearly at right angles, which, with a slightly upward inclination, to provide for drainage, runs in a northeasterly direction, but trending to the northward—that is, toward the sea—with a curve having a radius of one kilometer. It is to be 1,850 yards long. Artificial ventilation has not been found necessary so far. This gallery is about 170 ft. below low-water mark, but no portions of these workings have yet been pushed out under the sea. M. Alexandre Lavalley, the contractor for the Suez Canal, is to drive another gallery of equal length in the same direction as, but not immediately over, the one already begun. He will employ Brunton's cutting machine, while in the lower gallery Beaumont's machine will be used, both machines being driven with compressed air. It is found in the lower gallery that there is but little percolation of water, and that such as runs in comes from springs in fissures. What does flow in is pumped out at the rate of 60 gallons per minute.

The Southeastern Railway Company is prosecuting, at its own expense, the scheme first mentioned, but the Channel Tunnel Company has revived its original rival scheme, which, under the management of Sir John Hawkshaw, is being pushed forward with activity. The English terminus is to be at Biggin street, in the center of Dover, about 500 yards from the beginning of the tunnel proper. The tunnel will then proceed at a gradient of 1 in 80—the same gradient as the Southeastern scheme—in the direction of Farehole, St. Margaret's Bay, near the South Foreland, where it will leave the English shore, taking a course beneath the channel to meet the heading already commenced at Sangatte. The boring between St. Margaret's and Dover will be commenced at the former place, where drainage works will be constructed, and powerful pumps provided for the water it is expected will find its way into the heading in passing through the hills in the neighborhood of Dover. In the event of the company obtaining the consent of the government to their scheme, and provision having to be made for the Southeastern Railway Company to run over their line, the course which will most probably be adopted will be to connect the town by a tunnel from Shakespeare's Cliff, passing under the Western Heights.

The advantages of the channel tunnel are claimed to be numerous. The abominable channel passage, with the attendant horrors of sea-sickness, will be done away with, and while traffic is increased the time between London and Paris will be reduced from 9-11 hours to six or even five. With compressed air-engines, or probably electrical engines, the passage of the tunnel—twenty-one miles in length—will be made in half an hour, and the rest will depend upon an acceleration of speed on the French side of the railway journey. The advantage to the goods traffic in avoiding transshipments is too obvious to dwell upon. There is no right of way to purchase, and the material is so favorable that—unless a "fault" is developed in the gray chalk—the cost of driving the tunnel will be very small, less indeed than that of many a railroad cutting. The one point on which reform is necessary is the examination of baggage en route, but here probably the example of the American railways crossing into Canada can be followed and baggage examined in transitu or before leaving the terminus. According to the pamphlets issued in 1874 and 1875 the cost of the tunnel was to be £4,000,000, the estimates being, however, raised to £8,000,000 to cover any possible contingency. Sir Edward Watkin now says that working in a dry material so easy of manipulation he can construct the tunnel for a sum "wonderfully less" than any estimate. Colonel Beaumont declares that with one of his improved machines at each end of the tunnel a progress of fifty yards per day can be attained, only two men being employed with each, the machine delivering the material into the carts as it is scooped out. The *British Trade Journal*, however, recently attacked the whole scheme. "In constructing the Kilsby tunnel on the original London & Birmingham Railway," it said, "the engineers encountered a wet stratum, and the consequence was not merely to send up the cost £145 per yard, but to imperil the very construction of the line. The St. Gothard tunnel, the precise cost of which has yet to be ascertained, was estimated at £135 per yard. The Mount Cenis tunnel cast £195 per yard. The Thames tunnel, which is the nearest analogy, £1,299 per yard. The cost, therefore, may vary from £255,000 to £2,000,000 per mile, and assuming that the expense is only £348,000 per mile a traffic of £34,300 per mile a year will be required to pay 5 per cent. on the capital and working expenses. The average gross receipts of the railways in the United Kingdom are less than £3,600 per mile. The only railways that even approach the required sum are the metropolitan lines, which carry 3,500,000 passengers a year in trains following each other at intervals of three or four minutes for eighteen hours out of twenty-four. In 1878 the passenger traffic of the Southeastern Railway, whose chairman, Sir Edward Watkin, is getting up this scheme in the interests of its shareholders, was 71,997 per mile per annum, and if every one of these passengers had been conveyed through the tunnel to France, they would have composed 2 per cent. of the number required." However, the experience of scientific prophets during the past generation or so has not been of a character completely to dishearten Sir Edward Watkin or Sir John Hawkshaw.

The military aspects of the channel tunnel have been discussed at a length and in a manner that to Americans can only seem comic. Admiral Lord Dunsany, in the *Nineteenth Century*, says: "If the tunnel is made, even its warmest advocates must confess the necessity of such fortifications as shall secure to us the possession of our end of it. These fortifications must be sufficient to render a surprise or an escalade by a small force all but impossible. They must always be kept in the highest state of efficiency, and should be garrisoned by picked troops." Whatever contrivances might be invented for blowing up the tunnel and letting in the sea at a moment's notice, there would be no security against their being seized by a sudden night attack on the part of a couple of thousand men. "The enemy," urges Lord Dunsany, "who siezes our end of the tunnel will be masters of it; and as we are told that trains can easily be run the distance between France and England in half an hour, and that, as there are to be two lines of rails in the tunnel, trains can follow one another safely at intervals of 5 or 6 minutes, before morning broke 20,000 infantry might easily, having come through the tunnel, be in possession of Dover." Those who rely upon the present *entente cordiale* between England and France are warned that there is no guarantee against the sudden appearance of "an ambitious conqueror under the lawyer-like exterior of an elected minister or president," and even if there was no such cause for watchfulness and precaution it is unfair to expose neighbors to "so tremendous a temptation." Sir Garnet Wolseley is a sharer in his views, and they have been persistently echoed by the press. Indeed a brochure, after the fashion of "The Battle of Dorking" only not clever, has been issued and has become quite popular, in which the author describes how a handful of brave Frenchmen, disguised as tourists, obtained possession of the Dover end of the tunnel and facilitated the passage of an army which conquered England. Moltke, on the other hand, laughs at the idea, as he approves of the conclusions of a paper recently prepared by a Prussian officer, to the following effect: "To deprive the enemy of the use of the tunnel and render it impassable in case of a hostile attempt, one or two iron-clad forts should be erected at the mouth. They should be strong enough to resist all ordinary siege guns, while they could be placed so as effectually to enfilade the entrance to the tunnel. Another safeguard would be the construction of mines or chambers filled with explosives, which in case of necessity could be fired and blow up the mouth of the tunnel completely. A surprise might be effectually guarded against by stationing a small body of troops permanently at the mouth of the tunnel, under officers whose duty it would be to see that the strictest discipline was invariably carried out. The supposition of the capture of the tunnel and that its seizure would at once entail the danger of an invasion is based upon mere arbitrary conjectures which require a coincidence and concatenation of circumstances of almost impossible character. It presupposes, firstly, the gravest faults in failing to discern the right moment for taking the necessary precautions for securing the tunnel. Secondly, it assumes that a large body of troops can be conveyed to England without the fact becoming previously known that they were being massed for the purpose. It assumes, thirdly, that such a force could get possession of Dover and other forts, and the English garrison simply allow itself to be taken unawares; and it assumes, fourthly, that France could dispatch 30,000 men through the tunnel in five hours to establish a *tête de pont*. But it is notorious that the conveyance of such numbers secretly is an utter impossibility. To prevent such a *coup de main* as Sir Garnet Wolseley apparently apprehends, military engineers can devise the most perfect and effective means. "The invasion of England through the proposed tunnel I consider impossible. You might as well," said Europe's greatest strategist, pointing to the entrance to his library, "you might as well talk of invading her through that door." Appliances similar to those for blowing up the Rhine bridges at Cologne and Strasburg, which can at any moment be instantaneously done, would prove amply sufficient.—*New York World.*

CORRESPONDENCE.

METRIC LEVELING RODS.

(*Continued from Page 87.*)

legible the figures indicating units and tenths, even when only a very short length is visible. The second decimal place is obtained by counting not more than *four* centimeter blocks, leaving the third place of decimals to be estimated by the eye.

Two designs for metric leveling rods, divided and marked according to the foregoing principles, are shown below. They are drawn one-half full size.

Design No. 1 is used on the rods of the English telescopic pattern. They may be obtained from any of the leading dealers in engineering supplies. They are four meters in length when extended. When closed their length is about 1.60 m.

Design No. 2 was prepared by the writer about three years ago, and was one of several designs exhibited before the Boston Society of Civil Engineers at the presentation of the annual report of the Standing Metric Committee of that Society in the spring of 1879. This design is well adapted for a target rod, since all the centimeter blocks are on one side of the rod.

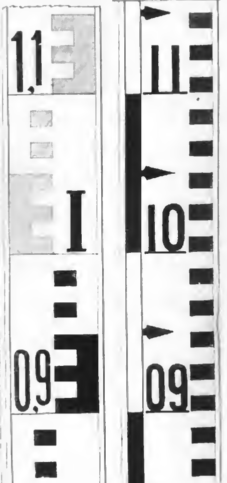
This communication would not be complete did it not contain a brief description of the peculiar leveling rods used by the French engineers.

The leveling instruments used in France are so constructed that the telescope may be reversed and inverted without turning the instrument upon its vertical axis, the level tube being on the bar of the instrument.

It follows from this construction that if two readings of the rod are taken, one with a direct telescope and the other with the telescope reversed and inverted, the average of the two will be a reading from which any errors due to imperfect adjustment of the instrument, or to irregular expansion of the level tube by heat, will have been eliminated.

This principle is made the basis of the French system of levelling, by which heights are obtained by the average of two operations, with very rare exceptions.

Metric Leveling Rods.
One-half size.
The shaded portion may be red.



No 1. No 2.

Now the average of two quantities *a* and *b* may be written—

$$\frac{a}{2}+\frac{b}{2}$$

a and *b* representing the two readings of the rod. The two half-readings of the formula are not obtained in the field by a division by two, which would involve great labor, but by marking the rod to a unit of *double size*, by which means the half-reading may be read directly from the rod. Thus, a length of *two meters* is taken, divided into tenths and hundredths, and numbered as if it were the unit of measure. The two designs above shown may be considered as representing rods of this character at a scale of *one-quarter* full size.

Another modification used in France, to gain greater distinctness in long sights, is to divide the artificial tenths on the rod into *five* parts of 4 centimeters, instead of ten parts of 2 centimeters each. These rods are read by estimating the *twentieth* parts of the divisions by the eye to obtain the third decimal figure. They are very extensively used.

Charles H. Swan, C. E.,
Chairman Committee on Manufactures of the American Metric Bureau.

THE INTERNATIONAL GRANITE QUARRY.

The quarry is situated on Grindstone Island, one of the far-famed Thousand Islands. It is distant from the town of Clayton, N. Y., four miles, and the same distance from Gananoque, on the Canada side. The altitude of the quarry is 62 ft. above high-water level, and contains stone enough to last many generations. In color the stone is of a beautiful jasper; and it is capable of taking a very high polish. It is much sought after for monumental and other purposes, being preferred for its beauty of color and durability to any red granite on this continent. It was from this quarry that the large columns supporting the roof of the Senate Chamber at the New Capitol, at Albany, N. Y., were procured. The Superintendent informs us that stones of any size can be obtained from it. The proprietor, R. Forsyth, of Montreal, purchased the quarry four years ago and has laid out a large sum of money in developing it.

◆

A SYSTEM OF DESIGNING HIGHWAY BRIDGES.*

[Before commencing this paper the writer wishes it to be understood that he does not consider the system here given to be the only correct one in existence, nor does he even claim that it is the best. It has been prepared by him for Messrs. Raymond & Campbell, bridge builders, of Council Bluffs, Iowa, and it is owing to their courtesy that he is now permitted to present it to the public.]

Ordinary highway bridges may be divided into two classes; those for use in cities, towns and their suburbs, where they will be subjected to heavy loads, and those for country roads, where the loads are necessarily lighter. The former for spans of 60 ft. or less should be proportioned to carry a load of one hundred pounds per square foot of surface, and for those above 60 ft. the load may be diminished gradually to seventy-five or even sixty pounds per square foot for spans of 200 ft., the working stress per square inch for iron in tension being usually five tons, though sometimes six and a quarter.

For country bridges the load varies from eighty to fifty pounds per square foot according to locality and length of span, the working stress per square inch for iron in tension, in nearly every case, being six and a quarter tons.

Some bridge companies have employed seven *and a half tons*, but this is now generally considered to be injudicious. The reason why long spans may be proportioned for lighter loads than short ones is the very small probability of a long span ever being entirely covered by the maximum load, while there is a chance of such an event taking place in case of a short span. It can easily be seen, then, that in all bridges of *any length* of span each panel should be proportioned to sustain the maximum load, for it is possible to load one panel heavily without loading any of the others.

This panel excess will effect only the sizes of the joists, floor-beams and beam hangers. Sometimes the panel excess is supposed to exist when the bridge from the nearest end up to the panel considered is covered by the moving load, which would affect also the sizes of the counters. This last requirement is very seldom taken into account.

Owing to the fact that there are far more country than city bridges built, the writer has paid more attention to the former than to the latter; and of the twenty tables which accompany this paper† two only (Nos. II. and XVIII.) are especially for city bridges, twelve (Nos. V.–XVI.) are especially for country bridges, while the remainder (Nos. I., III., IV., XVII., XIX. and XX.) may apply to either. On account of the great variation in the data for city bridges, it would require more labor to systematize them and tabulate the dimensions of their floor systems, as has been done for the country bridges in Tables V. to XVI. inclusive, than the number of city bridges to be built would warrant.

Each of the two classes of bridges is subdivided into three kinds—iron, combination and wooden. The last-mentioned will not be treated here, for, on account of the inferiority of wood for tension members, that style of bridge is fast passing out of existence.

At present there are probably more combination bridges being built in the West than there are iron or wooden ones. The reason is that the first cost of a combination bridge is but little more than half that of an iron one, and that, if properly cared for, it will last from twelve to twenty years, or even longer. By covering the chord and batter braces with sheet iron or shingles, several years may be added to its life.

The first step to take in making a design, is to make out a table of data for calculating the diagram of stresses. The form employed by the writer is as follows:

Single Intersection.

$n =$
$l =$
$d =$
$diag =$
$\sec\Theta =$
$\tan\Theta =$
$w =$
$W_1 =$
$W^l =$
$W^u =$
$W'' =$
$\frac{1}{n} w =$
$\frac{1}{n} w \sec\Theta =$
$W_1 \sec\Theta =$
$W'' \tan\Theta =$

Double Intersection.

$n =$
$l =$
$d =$
$short\ diag =$
$long\ diag =$
$\sec\alpha =$
$\tan\alpha =$
$\sec\beta =$
$w =$
$W_1 =$
$W^l =$
$W^u =$
$W'' =$
$\frac{1}{n} w =$
$\frac{1}{n} w \sec\alpha =$
$W_1 \sec\alpha =$
$\frac{1}{n} w \sec\beta =$
$W_1 \sec\beta =$
$W^l \tan\alpha =$

where n is the number of panels, l the length of each panel, d depth center to center of chords, Θ the inclination of diagonal ties to vertical, w live load per panel one truss, W_1 dead load per panel on one truss, $W'' = w + W_1$, W^u the portion of W_1 concentrated at upper panel point, W^l the portion of same concentrated at lower panel point, α the inclination of short diagonal tie to vertical, and β the inclination of long diagonal tie to vertical. Of these quantities l, n and d are usually to be determined by experience. Of course the length of span, width of roadway, and the live load per lineal foot are given; from these six quantities the rest of the table of data can be determined, although it may take several trials to find the dead load per lineal foot of bridge, from which W_1 is calculated. It is difficult to give directions for finding the dead load, but the writer hopes at some future time to treat that subject by itself. For the present, the following approximate and incomplete table must suffice; pine being figured at two and a half and oak at four and one-third pounds per foot, board measure.

Iron Bridges 16 ft. Clear Roadway. Lumber all Pine.

Length of span.	Dead load per lineal ft. on both trusses.	Live load per sq. ft.
Feet.	Lbs.	Lbs.
75	400	80
100	456	80
140	528	80
155	530	70
175	562	80
200	624	60

When pine floor and joists are used, the flooring being 3 in. thick, the average weight of lumber per lineal foot is 235 pounds; where oak floor and joists are used, the flooring being 2½ in. thick, it is 610 pounds.

For different widths of roadway the dead load will vary almost directly as the widths. Combination bridges of same span, roadway and moving load are from 7 to 10 per cent. heavier than iron ones.

In regard to the best values for n and d there is considerable difference of opinion among bridge builders. It is probably economical to employ long panels, though there seems to be an unfounded prejudice against them among most county commissioners and a few builders. It is probable, too, that greater depths of trusses than those generally used would be economical.

He employs the following proportions:

Span.	Depth of Truss.	Remarks.
30	4'	No side braces.
40	5'	" "
50	6'	" "
60	7½' to 10'	Above 7½' use side braces.
60	15'	Through bridge 4 panels.
80	16'	5 panels.
100	20'	5 panels.
125	23'	Vertical sway bracing.
150	25'	" "
175	28'	" "
200	30'	" "

As for the length of span at which it is economical to change from the single to the double intersection, this, too, is not yet fixed, but is probably about 140 ft.; this point will also be settled at the same time with the values of n and d.

Suppose, then, that the table of data is filled out; the next step is to find the stresses in the different members of the truss; the method for which, having received so much attention from various writers, will not be treated here. There is one point, however, that ought to be mentioned, viz.: that it is customary to subtract the effect of the dead from that of the moving load in each panel, when calculating stresses in counters. Professor Burr advises the contrary, for the purpose of keeping on the side of safety. This object is usually attained by straining iron to a less extent in the counters than in the main diagonals.

The hip verticals are usually strained to the same extent as the counters, viz.: four tons, when the main diagonals are strained five, or five tons when they are strained six and a quarter.

Having found all the stresses in the members of the truss, the next step is to calculate the sections. Let us suppose the bridge under consideration to be an iron one. First, find the areas of all the tension members and write them on the diagram immediately after the corresponding stresses, prefixing the areas with the letters *S R* (section required), then by the use of Carnegie's "Pocket Companion," pp. 88–100, ascertain the sizes necessary to give *at least* the section required, taking care that the sections are in good proportion.

The best proportion for chord bars is about one to four (width = 4 × thickness), a larger fraction causing an increased bending moment on the pin, and a smaller one being liable to increase its size on account of the limiting ratio of diameter of pin to depth of chord bar. For convenience in obtaining economical and standard sizes it is often preferable to vary from this ratio, even if it does affect the pin.

The same remarks apply to the main diagonals. Counters are usualy made square or round on account of the turn-buckles; it is better in most cases to make them double, though if they be small, single ones will do. Sometimes both single and double counters are employed in the same truss. Where there is an odd number of panels, the center diagonals should be made double and adjustable.

The sections of the tension members being determined, next comes the arrangement of the bottom chord. In small bridges all the diagonals, counters, chord bars and beam hangers can be packed between the post channels, but in larger ones some of the chord bars and often the diagonals (especially in double intersection bridges) have to be placed outside.

Compression members can be made of various sections, but the most common shape is the channel bar; the top chord and batter braces being composed of two of them with a plate on top and latticing or lacing below, and the posts of two, latticed or laced on both sides. For all but very small bridges—pony trusses—these shapes are the most economical and satisfactory. A single I beam for a post in a large bridge is not economical, for there is too much material near the neutral surface; it can be used to advantage, however, in small bridges, as in that case the waste of material is more than counterbalanced by the saving in shop work. For spans of 30 ft. and under, the I beam can be used advantageously in the chord and batter braces. It is often used for upper lateral struts, but because of the difficulty in making a neat connection, it is preferable in nearly every case to employ channels for that purpose. Four-inch six-pound channels are about as small as should be used, for 3-in. ones are too much cut up by the rivet holes.

In low pony trusses the use of side braces can be avoided by making the posts of two tee irons laced and spreading them outward from top to bottom. In combination bridges star iron is often employed in the same manner.

When used in this way, the tee and star irons should be made larger than theory would show, because of the initial tension in the counters, and other causes.

To proportion the top chord or batter brace for a given stress, where two channels and a plate are to be used, assume the depth of the channel and divide the length of panel by that amount, both numbers being expressed in the same unit.

Referring to table XVII. or XVIII., as the case may be, look down the column marked "Ratio of L to D," until the ratio just found is reached; the number to the right in one of the three columns is the working stress to be used. The three columns are for the three cases; both ends fixed, one end fixed and one hinged, and both ends hinged. These tables are calculated by the formulæ of C. Shaler Smith, C. E., to whom the writer is indebted for their use and for other valuable information in connection with bridge work.

The area of the top chord or batter brace is found by dividing the stress given on the diagram by the working stress taken from the table. From this area subtract that of the top plate and divide the remainder by two; the quotient is the area of each channel.

The thickness of the top plate should not be less than $\frac{1}{4}''$ nor greater than $\frac{3}{8}''$. If made $\frac{5}{16}''$, as is sometimes done, it is liable to be twisted out of shape while being transferred from the shop to the bridge site. It used to be customary, and the practice is still followed to some extent, to make the top plate of varying thickness, increasing from the ends of the truss to the center, making the channels of the same size throughout; but this method is not advisable, for the proper place for the larger part of the material in a chord like the one under discussion is in the channels and not in the plate. Similarly in any channel, the proper place for the larger part of tha material is in the flanges and not in the web, the reason being in both cases that the moments of inertia of the section in respect to vertical and horizontal axes are increased by removing a portion of the area away from tha neutral axes. The width of the top plate is dependent upon the depth of the channels and often also upon the manner of packing the bottom chord. The transverse distance between the center lines of the rivets, which attach the channels to the plates, should be never less and not (unless there be good reason) very much greater than the depth of the channels.

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* Paper read by J. A. L. Waddell, C. E., B. A. Sc., Member American Society of Civil Engineers, before the Pi Eta Scientific Society, Rensselaer Polytechnic Institute, Troy, N. Y.

† Although these tables are of great value, our limited space prevents our printing them. At the end of the article will be found the headings of the tables. The tables can be had by sending to the Secretary of the Pi Eta Scientific Society, Troy, N. Y., and remitting twenty-five cents.

The chord channels are sometimes spread apart in pony trusses so as to increase the lateral stiffness, and in any bridge it may be necessary to spread them a little to admit of a certain manner of packing below.

After finding the area of one channel in the chord, look in the table of channel sections employed and see if there be a *light* channel of this area; if not it will be necessary to assume a new depth of channel bar and proceed as before.

The greater the depth of channel, the less the ratio of length of strut to diameter, and consequently the greater the working stress and the less the cross-section, so it is well to use always the lightest and deepest channels posible.

Another reason for doing so is, that in the light channels there is relatively more material in the flanges than in the heavier ones.

It is usual, but not absolutely necessary, to make tha depth of the channels in the batter braces the same as that of those in the chords.

A slight difference in these dimensions will affect only the bevel in the hip joint. The posts are figured in a similar manner to the chords and batter braces, except that there is no plate; they are calculated for two-hinged ends, or one end fixed and one hinged, according to the detail employed in the upper post connection.

Next comes the determination of the sizes of the pins and the thicknesses of tha reinforcing plates.

Next comes the proportioning of the floor-system. For ordinary highway bridges, tables V. to XVI. will give all the necessary results without calculation; it is unnecessary to give any directions in regard to the use of these tables, for they are self-explanatory. The joists, of which tables V. and VI. give tha sizes, were figured from tables III. and IV., which were calculated by Trautwine's formula for wooden beams subjected to a deflection of $\frac{1}{360}$ of the span.

Tables VII., VIII., IX. and X. were also figured from tables III. and IV.

Tables XI. and XII. were partially taken from Carnegie's "Pocket Companion," and partially calculated by the formula for built beams

$H = \frac{W \times L}{8 D \times T} - \frac{1}{8} H' + H''$, where $H =$ the area of the upper flange, W the uniformly distributed load on the beam, L length of beam in inches, D the effective depth of same in inches, or the distance between tha centers of gravity of the upper and lower flanges; T the working stress for iron, in this case 10,000 pounds per square inch net section; H' the area of the web and H'' the area lost by the rivet holes. It is not necessary to add H'' for the upper flanges, but its value is so slight that it was hardly worth while to make any difference in the sizes of the angles. In large floor beams for city bridges, especially where top and bottom plates are used, it might be well to make a difference in the flange areas. In these the bottom plate need extend only half way from the center to the points of support. Care should be taken to use staggered rivets, and the areas lost by the rivet holes in the bottom plate and angles should be taken into account.

Many bridge companies reduce the depth of built beams at the ends, in order to save a little in weight of iron. This method may be advantageous to the company, but it is no saving to the manufacturer, for the triangular pieces cut from the web are wasted, and can be valued only as scrap-iron; besides, the extra work alone in cutting the web, bending the angles and making square rests for the beam-hanger nuts on the inclined flanges, more than counterbalances any saving of material. Tables XIII. and XIV. are to be used for bridges where the traffic is light, and tables XV. and XVI. for those subjected to heavy loads. It would undoubtedly be better to adopt the two latter tables altogether, but as very few companies figure the working stress in beam-hangers at four tons per square inch, it would place one at a disadvantage where competition is close.

In calculating a floor system not given in these tables, assume the total weight of the floor and joists in a panel, and to this add the live load on the panel. Then assume the dimensions of the joists, and calculate by table III. or IV. how many will be needed; should the result separate them more than two feet center to center, it will be necessary to assume smaller joists; while should it bring them more closely together than eighteen inches, it would be better to employ larger ones. The sizes of the wooden floor beams are to be calculated in a similar manner. Should the resulting weight of lumber prove to be greatly different from the assumed weight, it will be necessary to refigure.

Iron floor beams are to be proportioned by the formula already given. The calculation of sizes of beam-hangers is too simple to need explanation.

The only difference so far, between the calculations for an iron and for a combination bridge is in the proportioning of the top chord, posts and batter braces. The sections for these members are to be found by the aid of either Table I. or II., which are calculated by C. Shaler Smith's formula, as given in "Trautwine's Pocket Book." They give the working loads for square pillars; the load for a rectangular pillar is found by taking from the table, the working load for a square pillar whose sides are equal to the least side of the rectangle, and multiplying it by the ratio of the longer to the shorter side. The bolts are placed so closely together that the chords, batter braces and posts may be figured as solid pieces of timber.

It may seem that there ought to be some distinction made between fixed and hinged ends in calculating the dimensions of wooden struts; but where the posts are well attached to castings at top and bottom there is, after all, really very little difference between the conditions of posts, chords and batter braces, regarding their fixedness.

Next comes the proportioning of the upper and lower lateral systems, which is done by supposing a horizontal plane to divide tha truss midway between the chords, calculating the area per panel opposed to lateral wind pressure above and below this plane, doubling areas of truss members hand-railing, hub-plank, etc., but not that of joists and flooring, adding together all the areas above the horizontal plane, and multiplying the result by the assumed pressure, to find the panel load for the upper system, and dealing similarly with those below this plane to find the panel load for the lower system. In iron bridges the "Pratt system" of lateral bracing (diagonals in tension and transverse members in compression) is employed above and below, while in combination bridges that system is used below, and the "Howe system" (diagonal wooden struts and transverse members round rods), is ordinarily employed above.

The "Howe system" is both cheaper and stiffer than the "Pratt," but of course can be employed in combination and wooden bridges only, for it is never economical to make inclined members in iron bridges to resist compression, and the verticals or transverse members, as tha case may be, to resist tension.

In the "Pratt system" it is customary to attach tha upper lateral rods to the pins, though other devices are sometimes resorted to, and the lower lateral rods to the floor beams, making the latter act as struts for the lower system, though the effect of wind pressure on them is seldom if ever taken into account.

The method usually adopted is faulty, inasmuch as any two adjacent rods are not in the same horizontal plane, and consequently their tendency when strained is to twist the floor beam; besides, they are attached to the web, which is the weakest and most flexible part of the beam. These difficulties may be overcome by fastening two adjacent rods to a pin passing through the web, which should be reinforced at the pin-hole, and stiffened by four vertical angle iron, placed about 6 or 8 in. on each side of the pin.

This method necessitates the use of bent eyes on the ends of lateral rods, which is objectionable if the diameters be large, in which case it would be better to use four pieces of 4 in. × 6 in. angle iron, about 12 in. long, two on each side of the beam, the 4 in. legs being riveted to the web, and the 6 in. ones having holes, through which pass pins for the lateral rod attachment.

The stresses in the lateral systems are usually calculated as if the wind pressure were a fixed load, but the writer prefers to assume that it is a moving one, as that will produce larger stresses in the center and intermediate members; and in point of fact the wind is liable to strike one side of the bridge at a time.

There has been considerable discussion of late in engineering periodicals concerning wind pressure, and it has been virtually decided that thirty pounds per square foot are sufficient for long spans. The writer uses forty pounds up to 100 ft., thirty five pounds from 100 ft. to 180 ft., and thirty above 180 ft.

Tension members in the lateral systems should be proportioned for a working stress of seven and a half tons, and the compressive members by tables I. or XVII. In using table I., one diagonal should be figured for tha whole length, and the other, which is doweled to tha first, for half length.

In many cases the stresses found in the upper system call for sections which would be practically altogether too small. No rods less than three-quarters of an inch in diameter, nor channels less than four inches in depth, should be employed.

For spans of one hundred feet the upper lateral rods should vary from three-quarters of an inch at the center to one inch at the ends, and for spans between one hundred and one hundred and forty feet the end upper lateral rod should be not less than one and one-eighth inches in diameter.

The portal bracing should in all cases be stronger than the stresses would indicate, for it is subject at times to excessive shocks. Whenever the headway will permit of its being done, the wind bracing should be extended down the batter braces, and in all highway bridges above twenty-three or twenty-four feet in height between centers of chords, there should be intermediated struts and tension members between the opposite posts. In the lower lateral system there should be placed at each end of the bridge a strut, usually of tee iron, or I beam to keep the chords apart and to transfer any stress that is not taken up by the friction of the shoe plate. The manner of determining the area of the section of the end strut is somewhat arbitrary. At the roller end it can be found by adding together the transverse component of the stress in the end diagonal and one-half a panel load of wind pressure and subtracting from the sum one-quarter of the weight of the bridge when empty, multiplied by the coefficient of friction of iron upon iron, and proportioning the strut to resist this compression. If the strut at the fixed end of the bridge be made of the same size as that at the roller end, the error so involved will be on the side of safety.

After finding the stresses in the lower lateral system, it should be observed whether the longitudinal components of the stresses in the lateral diagonals near the end of the bridge exceed the stresses due to dead weight alone in the bottom chord of the corresponding panels.

If they do, the chord bars will have to be stiffened so as to resist a compression equal to the difference between the longitudinal component of the lateral stress and the existing tension. Unless this point be attended to there is no use employing a strong lateral system, for should tho latter be strained up to its working limit it would buckle the bottom chord and destroy the bridge. In nine cases out of ten this consideration is not taken into account.

Soma engineers prefer to make tha bottom chords stiffened throughout the whole structure and to rest the joists thereon, thus obviating the use of floor beams.

It is questionable if this method be an economical one, but undoubtedly it makes a very firm structure. The following calculations mada for the case of channel bottom chords may prove useful to some one designing a bridge with transverse joints:

Let T be the tension in the bottom chord of any panel as shown by the diagram of stresses. Let l = length of panel in inches, W = distributed load in pounds resting on a single panel of tha bottom chord in one truss, or in other words one-half the weight per panel of flooring and load thereon, M = maximum moment due to bending, then, as the beam is fixed at both ends and loaded uniformly, $M = \frac{1}{12} lW$.

A = area in square inches of section of bottom chord in one truss, then $\frac{A}{T}$ = tension per square inch due to direct stress.

Let I = moment of inertia of A about the horizontal plane passing through the center of the channels.

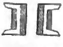
R = greatest allowable stress per square inch and $R = R - \frac{T}{A}$. Also let d = depth of channel in inches, then

$$M = \frac{R\,I}{\frac{d}{2}} = \frac{2\,I\left(R - \frac{T}{A}\right)}{d} \qquad \therefore I = \frac{Md}{2\left(R - \frac{T}{A}\right)}$$

Now as I depends directly upon A, it will be necessary to assume a value for the latter, the depth d being decided upon at the same time, then substitute in the last equation and see if it makes both sides equal.

If not, it will be necessary to assume another value for A, substitute again, and so on, until a value be found that will make the equation hold true. Two or three trials will usually be sufficient. It is to be noticed that A is the area of the channels over and above that lost by the punching of the rivet holes. This method is *only approximate* as it assumes the neutral surface to be at the center of the channels, but any error that there may be is on the side of safety.

To find the necessary cross section of the splice



plates, let D be the average depth of the exterior and interior splice plates shown in section in diagram, b = the sum of their widths, then the moment of inertia is approximately $\frac{1}{12}bD^3$, and the moment

$$M_1 = \frac{\left(R - \frac{T}{bD}\right)bD^3}{12\frac{D}{2}} \quad \therefore b = \frac{6M_1 + TD}{RD^2}$$

The splice plate being a short distance to one side of the panel point M_1 is a little less than M, but, if it be assumed to be the same, the error will be on the side of safety.

To the thickness thus found is to be added a small percentage for the rivet holes.

Let b' be the increased value of b, then $\frac{b'}{4}$ is the average thickness of the plates.

The thickness of the exterior plate should be a little greater and that of the interior plate a little less than $\frac{b'}{4}$.

In case bottom plates attached to the flanges be used let I' be the moment of inertia of their cross section about the middle of the bottom chord, and let A be the sum of the areas of their sections, then

$$M_1 = \frac{\left(R - \frac{T}{bD + A_1}\right)\left(\frac{1}{12}bD^3 + I'\right)}{\frac{D}{2}}$$

$$\therefore b = \frac{6M_1D - RD^2A_1 + TD^2 - 12I'R}{2RD^3} \pm$$

$$\sqrt{\frac{6M_1DA_1 + 12I'RA_1 - 12TI'}{RD^4} + \left(\frac{6M_1D - RD^2A_1 + TD^2 - 12I'R}{2RD^3}\right)^2}$$

The upper sign is the one to be used, as the lower one would make the value of b negative.

To find the number of rivets necessary for the splice, suppose them arranged in two, three or four horizontal rows according to the depth of the beam, the pitch being made about two and a half times the diameter of the rivets, and the rows breaking joint.

Let p = the pitch and n = the number of rivets in the bottom horizontal plane of rivets on each side of the splice.

Let h = the diameter and a the area of a rivet and let n', h' and a be the corresponding values for the rivets in the bottom plates. Assuming the iron in the plates, whose cross-section is A_1, to be strained up to the limit R, their resistance will be $R\,A_1$, which should equal $n'\,a'\,S$, where S is the working resistance to shearing or should equal $n\,h'\,t'\,C$ where t' is the thickness of the plate and C the working compressive stress per square inch.

The greater value of n' given by these equations is the one to be used.

Assuming where no flange splice plates are used that the bottom row of rivets in the side plates takes up all the stress in these plates below the horizontal plane passing half way between the two lower rows of rivets, and finding the average resistance per square inch (R'') on the portions (A_2) of the plates below this horizontal plane, under the assumption that the neutral surface lies about ½ or ⅔ of the depth of the channels from the top, $R''\,A_2$ should equal $2\,naS$ or $nhtC$, where t is the thickness of the web. As before the larger value of n should be taken.

It is almost needless to say that these investigations are of a very approximate character, being based upon several assumptions that are not theoretically correct.

In making out bills of material, the accompanying list of members will prove of great assistance. By their use one can avoid all possibility of an underestimate by an omission of any of the parts of the structure. A good way to make out a bill of material is to prepare six vertical columns, in the first of which write the name of the member, in the second the number of pieces, in the third and fourth the dimensions determining their section, in the fifth their length, and in the sixth the weight of all the pieces, or, if of wood, the number of feet, board measure, that they contain.

The following examples will serve to explain the method:

Bill of Wrought Iron.

Chord channels ...	12	7"	10¼lb	22'	2,772lb
B. B. channels.....	8	8"	12½lb	33' 9"	3,375
Plate	1	¼"	12"	262'	2,090
Post channels.....	8	3"	6½lb	22'	1,144
Lateral struts.....	4	4"	6lb	13'	300
" "	4	5"	6½lb	13'	300
Main diagonals....	8	3¼"	1⅛"	34'	1,090
Counters....	8	⅝"	⅝"	35'	525
etc	etc.	etc.	etc.	etc.	etc.

Bill of Lumber.

Top chord..........	10	17"	12"	20'	3,400
Batter brace.	8	8"	14"	30'	2,240
Posts	4	9"	10"	22'	660
"	4	7"	10"	22'	513
Tie beams	2	6"	8"	18'	144
Lateral braces.......	2	7"	9"	26'	273
" "	4	6"	9"	26'	468
etc.............	etc.	etc.	etc.	etc.	etc.

It is to be noticed that it is often convenient, as in the case of the "Plate" in the "Bill of Wrought Iron," to combine several lengths into one, or as in the "Top Chord," in the "Bill of Lumber," to use one cross section (17 × 12), instead of several (2 — 4½" × 12 & 1 — 8 × 12).

To the length of each chord-bar, main diagonal and hip-vertical is added 3 ft. to allow for the weight of the eyes, and to that of each adjustable rod about 5 ft. Should greater accuracy be required for the latter, it will be necessary to ascertain what length of the rod is needed at each end for the connection and how much for the adjusting-nuts and upset ends, by the following table of

Equivalent Lengths of Rods for Upset Ends, Nuts, Sleeve-Nuts and Turn-Buckles.

(⅜"—1") — 1 upset end and 1 nut — 1½ feet of rod.
(1 1/16"—1 15/16") — " " " — 1¾ " " "
(1 7/8"—2") — " " " — 1½ " " "
(2⅛"—2⅝") — " " " — 1 11/16" " " "
(½"—1⅛") — 2 up. ends and 1 s. nut — 2⅝ " " "
(1 3/16"—2½") — " " & T buckle — 3 " " "

These equivalent lengths do not include the lengths of the upset ends themselves; they represent simply the extra length to be added to the bar to equalize the weight of the nuts, sleeve nut, or turn-buckle, and the extra iron for the enlarged ends, which are generally about eight inches long.

To estimate at all accurately the sizes of the details in order to obtain their weights, requires a knowledge of detail that can only be obtained by practice.

In some cases theory can be used to determine the sizes required, but very often some practical consideration will cause to be adopted a size different from that called for by theoretical considerations. It is not necessary in a preliminary estimate to have the exact quantities of materials; approximate dimensions will therefore be sufficient.

In making a hurried estimate of the weight of wrought iron in a bridge, it is the practice of the writer to calculate the weights of the members in the lists, under the heading "Main portions," making the allowances of extra length before-mentioned, and to divide their sum by 0.85. The result is a pretty close approximation to the total weight of wrought-iron.

Estimate of cost can be made very readily by using a blank similar to the following:

Estimate on..............Bridge across..............
....
Length Span......ft. Height......ft. Clear Roadway ......ft. Static Load per lineal foot......lbs. Moving Load per lineal foot......lbs. No. Panels...... Length Panels........ft.

	$	Cts.
Wrought Iron, lbs........@..................		
Sheet Iron, lbs........@..................		
Cast Iron, lbs........@..................		
Lumber, ft........@..................		
Piles, ft........@..................		
Hauling............Loads @..................		
Freight..................................		
Framing..................................		
False work................................		
Erection..................................		
Spikes....................................		
Painting..................................		
Blacksmithing.............................		
Coal......................................		
Freight on Tools..........................		
Traveling Expenses........................		
Men's Time Traveling		
Bidding Expenses..........................		
Teaming during Construction...............		
Incidentals...............................		
Total Cost of Bridge......................		
Cost per Lineal Foot......................		

A very convenient table is one giving the cost of raising and of framing bridges of different lengths of span and widths of roadway. Such a table is not given here, for each bridge company will figure the cost differently.

Estimates of cost should be liberal, for in most cases the actual profits on bridges fall short of the amounts estimated.

Table XIX. is for finding lengths and weights of lattice bars, where the section, pitch and spread are given. The lengths were obtained by diagram, so are not very exact. The table is used *for estimates only.*

Table XX. is for finding the number of rollers at an expansion joint where their diameter is given, or for finding their diameter when their number is given. Of course their length and the total pressure are known quantities. All these tables are reliable, for they have been checked either by simultaneous figuring or by the method of differences.‡

While employing the latter the writer came across a curious mathematical fact, which, though possibly known before, may be as new to others as it was to himself. Taking the expression CX^n where C is any positive number and n any positive integer and letting X increase by any constant quantity d, let us form a series, placing the numbers in their regular order in a horizontal line. Then from the second number subtract the first and place the remainder under the second number, from the third subtract the second, etc., thus forming a second series. Then treat this second series as was treated the first and so on until the n^{th} set of differences is reached, when the numbers in this set will all be found to be equal.

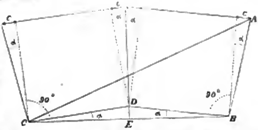
Owing to the necessary inexactness of the last decimal place, the n^{th} set of differences in checking the tables gave results, which, when the tables were properly figured, differed from each other by less than a certain quantity. It is very easy by following the series backwards to locate the position of an error.

There remains now to be discussed only the making of the working drawings, and as this paper has already exceeded the limit originally intended, this matter will be treated briefly.

The first step in making drawings for a span is to construct on a scale of say 1 in. to the foot, the skeleton of one-half of same showing the camber.

For single intersection bridges the latter, and its effect on the length of the diagonals, can be found by Trautwine's formula; for double intersection bridges the following calculations may be of use:

METHOD OF FINDING THE LENGTH OF DIAGONAL IN A DOUBLE INTERSECTION BRIDGE.



Let l = panel length in bottom chord = GD = DB.
c = ½ increase of panel length in top chord.
d = depth of truss between centers of chord = AB.
α = angle between radial line at panel pt. and ⊥ to chord.

$$\text{Then } \alpha = \sin.^{-1}\frac{c}{d} \qquad \text{(Eq. 1)}$$

$$DE : c :: l : d \quad \therefore DE = \frac{cl}{d}$$

$$BG = 2\,GE = 2\sqrt{l^2 - \frac{c^2l^2}{d^2}}$$

$$= 2l\sqrt{\frac{d^2 - c^2}{d^2}} \qquad \text{(Eq. 2)}$$

For railroad bridges and in highway bridges of small camber BG can be taken equal to $GD + DB = 2\,GD$ without perceptibly affecting the final result.

In triangle ABG, AB and BG are known; also angle $ABG = 90° + 2\,\alpha$.

$$AB + BG : AB - BG :: \tan.\tfrac{1}{2}\,[180° - (90° + 2\,\alpha)] : \tan.\tfrac{1}{2}\,[BAG - BGA]$$

$$\therefore BAG - BGA =$$

$$2\tan.^{-1}\left[\frac{AB - BG}{AB + BG}\tan.(45° - \alpha)\right] \qquad \text{(Eq. 3)}$$

$$(BAG - BGA) + (BAG + BGA) = 2\,BAG = (BAG - BGA) + (90° - 2\,\alpha) \qquad \text{(Eq. 4)}$$

which gives BAG.

$BGA = 180° - (BAG + 90° + 2\,\alpha) = 90° - (BAG + 2\,\alpha)$.

$AG = AB\cos.BAG + BG\cos.BGA$ = length of diagonal required.

---

‡ This will be true after making the corrections indicated in the list of errata.

After finishing the skeleton, the elevation should be filled in and all joints and details drawn to a larger scale—full size if possible.

Every member in the bridge, duplicates of course excepted, should be shown in at least two projections unless the development method be employed, which is seldom advisable, as workmen have difficulty in understanding it.

The principal point to be looked after in making the drawings is to have the structure just as strong in detail as in the main members, to which end it is necessary to pay strict attention to the reinforcing and riveting.

A few rules for the latter can be found in Rankine's "Applied Mechanics" and elsewhere, but there is greatly needed an exhaustive treatise on the subject in all its detail by some well-posted mechanical engineer.

Where a pin bears against a reinforced web it is necessary to know how much of the pressure is taken up by the web and how much by the reinforcing plate or plates in order to calculate the number of rivets.

Undoubtedly that part of the bearing next to the members producing the pressure will be subject to greater intensity of stress than the parts more remote, so that if the reinforcing plate come next to those members it would not do to estimate on an uniform intensity. It is possible to figure out the intensity theoretically, but any slight imperfection in the workmanship at the pin-hole would render all the calculations useless, so it is much better to figure on the average intensity for remote reinforcing plates and to add a good percentage to same for those adjacent.

LIST OF THE DIFFERENT MEMBERS IN A COMBINATION HIGHWAY BRIDGE.

WOOD.

Top Chords.
Batter Braces.
Vertical Posts.
End Tie Beams.
End Diagonals.
Floor Beams.
Flooring.
Batter Brace Stiffeners.
Lateral Braces.
Joists.
Hand Rail Cap.
Hub Plank.
Hand Rail Post.
Felloe Plank.
Corbels.
False Caps.
Wall Plates.
Cover Boards for Chords and Batter Braces.
Lath for Same.
Cross Diagonals in Deck Bridge.
Lower Lateral Struts in Deck Bridge.

WROUGHT IRON.

Main Portions.

Main Diagonals.
Counters.
Hip Verticals.
Upper Lateral Rods.
Lower Lateral Rods.
Bottom Chord Bars.
End Lateral Struts.
Batter Brace Ties.
Star Iron Side Braces.
Cross Diagonals in Deck Bridge.
Lower Lateral Struts in Deck Bridge.
*Floor Beams.
Beam Truss Rods.

* For details of Built Floor Beams, see List of Members in Iron Highway Bridges.

DETAILS.

- Bolts.
  - Chord Bolts.
  - Batter Brace Bolts.
  - Post Bolts.
  - Bracket Bolts.
  - Hand Rail Post Bolts.
  - Name Plate Bolts.
  - Bed Plate Bolts.
  - Expansion Pedestal Fastening to Bed Plate.
  - Lower Lateral Rod Bolts.
  - Drift Bolts.
  - Floor Beam Packing Bolts

Beam Hangers.
Beam Hanger Plates.
Hip Vert. Plates on Castings.
Lacing on Hip Verticals.
Side Brace Connection to Chord.
Pins.
Side Brace Connection to Floor Beams.
Lateral Rod Connection to Floor Beams.
Rollers and Roller Frames.
Jaws on End Struts.
Dowels for Upper Laterals.
Fillers for Pins.

Special Wrought Iron Details.

Hip Joint Boxes.
Upper Chord Panel Connection.
Lower Post Sockets.
Pedestals.
Bed Plates.

Corrugated or Galvanized Iron.

Cover for Top Chords and Batter Braces.

Cast Iron.

Bed Plates.
Hip Joint Boxes or Hoods.
Pedestals.
Upper Post Sockets.
Upper Chord Panel Connection.
Lower Post Sockets.
Lateral Angle Blocks.
Name Plates.
Brackets.
Washer Plates for Main Diagonals and Counters.

- Washers.
  - Chord Bolt Washers.
  - Batter Brace Bolt Washers.
  - Post Bolt Washers.
  - Upper Lateral Rod Washers.
  - Lower Lateral Rod Washers.
  - Beam Hanger Washers.
  - Name Plate Bolt Washers.
  - Bracket Bolt Washers.
  - Hand Rail Post Bolt Washers.
  - Bed Plate Bolt Washers.
  - Bevel Washers.
  - Floor Beam Bolt Washers.
- Packing Washers
  - Chord Bolt Packing Washers.
  - Lateral Rod Packing Washers.
  - Batter Brace Bolt Packing Washer.
  - Tie Bar Packing Washers in Batter Braces.
  - Post Bolt Packing Washers.
  - Bracket Bolt Packing Washers.
  - Floor Beam Bolt Packing Washers.

LIST OF THE DIFFERENT MEMBERS IN A WROUGHT-IRON HIGHWAY BRIDGE.

MAIN PORTIONS.

- Channel Bars.
  - Top Chords.
  - Batter Braces.
  - Posts.
  - Lateral Struts.
  - Portal Braces.
- Plate.
  - Top Chords.
  - Batter Braces.
- T Iron. Lower Lateral Struts.
- I Beams.
  - Floor Beams.
  - Intermediate Struts.
  - Upper Lateral Struts.
  - Lower Lateral Struts.
  - Top Chords.
  - Batter Braces.
- Bars.
  - Main Diagonals.
  - Counters.
  - Hip Verticals.
  - Upper Lateral Rods.
  - Lower Lateral Rods.
  - Cross Diagonals on Batter Braces.
  - Cross Diagonals on Posts.
  - Lower Chord Bars.
- Star Iron.
  - Side Bracing.
  - Hip Verts.

IRON HAND RAILING.
FLOOR BEAMS.
BEAM TRUSS RODS.

DETAILS.

- Plates.
  - Stay Plates.
    - Top Chords.
    - Ends of Posts.
    - Middle of Posts.
    - Ends of Lateral Struts.
    - Batter Braces.
    - Portal Braces.
  - Reinforcing Plates.
    - Hip Inside.
    - Hip Outside.
    - Top Chord Intermediate Panel Points Inside.
    - Top Chord Intermediate Panel Points Outside.
    - Bottom Chord Intermediate Panel Points Inside and Outside for Channel Bottom Chords.
    - Shoe Inside.
    - Shoe Outside.
    - Lower Ends of Posts Inside.
    - Lower Ends of Posts Outside.
    - Middle of Posts Inside.
    - Middle of Posts Outside.
    - Floor Beam at Holes for Beam Hangers.
    - Floor Beam Lateral Connections.
  - Filling Plates.
    - At Panel Points of Top Chord.
    - Floor Beams.
  - Cover Plates.
    - Shoe.
    - Hip Joint.
    - Intermediate Panel Points Top Chord.
  - Connecting Plates.
    - Batter Brace to Top Chord.
    - Posts to Top Chord.
    - Lateral Struts to Top Chord.
    - Intermediate Struts to Posts.
    - Portal Braces to Batter Braces.
    - Lateral Connection to Floor Beams.
    - Name Plates.
    - Top Plate in Floor Beam.
  - Shoe Under Plates.
  - Roller Plates.
  - Beam Hanger Plates.
- Lacing or Latticing.
  - Top Chord Upper.
  - Top Chord Lower.
  - Batter Brace Upper.
  - Batter Brace Lower.
  - Posts.
  - Lateral Struts.
  - Portal Braces.
- Trussing.
  - Posts.
  - Lateral Struts.
  - Portal Braces.
- Pins.
  - Bottom Chord.
  - Top Chord.
  - Middle of Posts.
  - Upper Lateral Connection.
  - Lower Lateral Connection.
  - Cross Diagonal Connection.
- Bolts.
  - Bracket Bolts.
  - Name Plate Bolts.
  - Cross Diagonal Bolts in Batter Braces.
  - Cross Diagonal Bolts in Posts.
  - Bed Plate bolts.
  - Expansion Pedestal Fastening to Bed Plate.
  - Upper Lateral Rod Connection to Chords.
  - Lower Lateral Rod Connection to Floor Beam.
  - Hand Rail Post Bolts.
  - Lateral Strut Connection to Chord.
  - T Iron Brace Bolts.

BRACKETS FOR PORTALS INCLUDING ORNAMENTAL WORK.

- T Iron Braces
  - Posts to Lateral Struts.
  - Stiffeners in Built Floor Beams.

BEAM HANGERS.
EXPANSION ROLLERS.
ROLLER FRAMES.
FILLERS FOR PINS.
TURN-BUCKLES.
SLEEVE NUTS.

- Jaws.
  - Upper Lateral Struts.
  - Intermediate Lateral Struts.
  - Lower Lateral Struts.
- Angle Iron
  - Intermediate Struts to Posts.
  - Upper Lateral Struts to Chord.
  - Lower Lateral Struts to Pedestal.
  - Lower Lateral Struts to Chord (Channel Lower Chords).
  - Batter Braces to Shoe Under Plates.
  - Side and End Angles for Roller Plates.
  - Angles in Built Beams.
- Pieces of Channels
  - Upper Lateral Strut Connection.
  - Lower Lateral Strut Connection.
  - Batter Brace Channel Connection to Shoe Under Plates.

WASHERS FOR HAND RAIL POST BOLTS.

- Rivet Heads.
  - Top Plate to Chord and Batter Brace Channels.
  - Latticing or Lacing to Channels in Top Chords, Posts and Struts.
  - Latticing to Latticing in same.
  - The various Stay Plates to Channels.
  - The various Reinforcing Plates to Channels.
  - Cover Plates to Channels.
  - Connecting Plates to Channels, etc.
  - Lateral Connection to Floor Beam.
  - Trussing to Channels or Bars.
  - Trussing to Trussing.
  - Ornamental Work in Brackets.
  - T Iron Braces to Posts and Struts.
  - Jaws to Lateral Struts.
  - The various Angle Irons to the parts which they connect.
  - The various pieces of Channels to the parts which they connect.
- Details of Built Beams.
  - Web.
  - Top Plate.
  - Upper Angles.
  - Lower Angles.
  - Stiffening Angles.
  - T Stiffeners.
  - Filling Plates.
  - Lateral Rod Connection.
  - Reinforcing Plates at Beam Hanger Holes.
  - Rivet Heads.

LUMBER.

JOIST.
FLOORING.
HAND-RAIL CAP PIECES.
HAND-RAIL POSTS.
HUB PLANK.
FELLOE PLANK.

Headings of tables accompanying the above paper:

Table I.—Table of working stresses in tons of 2,000 lbs. for square wooden pillars, calculated by the formula $P = \frac{0.625\,A}{1 + 0.004\,\frac{L^2}{D^2}}$ where P is equal the working stress, A the area in square inches, L the length in inches, and D the length of side of square in inches.

Table II.—Table of working stresses in tons of 2,000 lbs. for square wooden pillars, calculated by the formula $P = \frac{0.5\,A}{1 + 0.004\,\frac{L^2}{D^2}}$ where P is equal the working stress, A the area in square inches, L the length in inches, and D the length of side of square in inches.

Table III.—Table for finding the safe uniformly distributed loads that can be borne by pine beams, the loads being those which will produce a deflection of only $\frac{1}{480}$th of the span, calculated by Trautwine's formula $W = \frac{d^3}{16l^2}$ where W = load in tons, d = depth of beam in inches, and l = length of span in feet. To find the safe distributed load for any given beam, look in the upper horizontal line for depth of beam in inches and left hand vertical line for length of span in feet. The number found at the intersection of a vertical line through the former and a horizontal line through the latter multiplied by the width of the beam in inches will give the load required.

Table IV.—Table for finding the safe uniformly distributed loads than can be borne by oak beams, the loads being those which will produce a deflection of only $\frac{1}{480}$ of the span, calculated by Trautwine's formula $W = \frac{d^3}{11.5l^2}$ where W = load in tons, d = depth of beam in inches, and l length of span in feet. To find the safe distributed load for any given beam, look in the upper horizontal line for depth of beam and in left hand vertical line for length of span in feet. The number found at the intersection of a vertical line through the former and a horizontal line through the latter multiplied by the width of the beam in inches will give the load required.

Table V.—Table of pine lumber required per panel in 80-pound highway bridges, including joists, flooring, hand-rails, hub-rails, guard-rails and waste material, where pine only is employed. Flooring, 3″ thick; hand-rail posts, 4″ × 6″ × 4′; hand-rail, two pieces, 2″ × 6″; hub-rails, 2″ × 12″; and guard-rails, 6″ × 6″.

Table VI.—Table of pine and oak lumber required per panel in 80-pound highway bridges, where the joists and flooring are of oak and the rest pine. Flooring, 2½″ thick; hand-rail posts, 4″ × 6″ × 4′; hand-rails, two pieces, 2″ × 6″; hub-rail, 2″ × 12″; and guard-rail, 6″ × 6″. The upper figures in each rectangle are for pine, the lower for oak. The quantities include waste material.

Table VII.—Table of sizes of pine floor beams in 80-pound highway bridges, where pine only is employed.

Table VIII.—Table of sizes of pine floor beams in 80-pound highway bridges, where oak joists and flooring are employed. Flooring, 2½″ thick.

Table IX.—Table of sizes of oak floor beams in 80-pound highway bridges, where all the wood used, except that of the floor beams, is pine.

Table X.—Table of sizes of oak floor beams in 80-pound highway bridges, where the flooring and joists are of oak and remainder of pine. Flooring, 2½″ thick.

Table XI.—Table of iron floor beams for 80-pound highway bridges, where pine only is employed. This table is calculated on the hypothesis that the beams are so well stiffened in the direction of the trusses by the joists, that they would fail first on the side subjected to tension. Maximum stress per □″ for rolled beams = 6 tons; for built beams 5 tons per □″ net section.

Table XII.—Table of iron floor beams for 80-pound highway bridges, where the joists and flooring are of oak (flooring 2½″ thick) and remainder of lumber pine. This table is calculated on the hypothesis that the beams are so well stiffened in the direction of the trusses by the joists that they would fail first on the side subjected to tension. Maximum stress per □″ for rolled beams = 6 tons; for built beams 5 tons per □″ net section.

Table XIII.—Table of sizes of beam hangers, and the number used per beam in 80-pound highway bridges, where the joists, flooring, hand-rails, etc., are all pine. Up, denotes ends upset; N. Up, ends not upset. *Working stress per □″ = 5 Tons.* The table is figured for oak floor-beams, so is slightly in excess for pine or iron ones.

Table XIV.—Table of sizes of beam hangers, and the number used per beam in 80-pound highway bridges, where the joists and flooring are of oak and remainder of lumber pine, flooring 2½″ thick. Up, denotes ends upset; N. Up, ends not upset. *Working stress per □″ = 5 Tons.* The table is

figured for oak floor-beams, so is slightly in excess for pine or iron ones.

TABLE XV.—Table of sizes of beam hangers, and the number used per beam in 80-pound highway bridges where the joists, flooring, hand-rails, etc., are all pine. Up, denotes ends upset; N. Up, ends not upset. *Working stress per □″ = 4 Tons.* The table is figured for oak floor-beams, so is slightly in excess for pine or iron ones.

TABLE XVI.—Table of sizes of beam hangers, and the number used per beam in 80-pound highway bridges, where the joists and flooring are of oak and remainder of lumber pine; flooring, 2½″ thick. Up, denotes ends upset; N. Up, ends not upset. *Working stress per □″ = 4 Tons.* The table is figured for oak floor-beams, so is slightly in excess for pine or iron ones.

TABLE XVII.—Table of working stresses per square inch in tons of 2,000 lbs. for Highway Bridges—Columns composed of two latticed channel bars.

$$\text{Formula } p = \frac{\dfrac{f}{1+\left(\dfrac{Hr}{C}\right)}}{4+\dfrac{H}{30}} \text{ where } p = \text{working stress per } \square''. \qquad f = \begin{cases} 38500 \text{ for } \square\ \square \\ 38500 \text{ for } \circ\ \square \\ 37800 \text{ for } \circ\ \circ \end{cases}$$

$$C = \begin{cases} 5820 \text{ for } \circ\ \square \\ 3000 \text{ for } \circ\ \circ \\ 1900 \text{ for } \circ\ \circ \end{cases} \qquad H = \frac{\text{Length}}{\text{Diameter}}.$$

TABLE XVIII.—Table of working stresses per square inch in tons of 2,000 lbs. for Railway Bridges—Columns composed of two latticed channel bars.

$$\text{Formula } p = \frac{\dfrac{f}{1+\left(\dfrac{H^2}{C}\right)}}{4+\dfrac{H}{20}} \text{ where } p = \text{working stress per } \square''. \qquad f = \begin{cases} 38500 \text{ for } \square\ \square \\ 38500 \text{ for } \circ\ \square \\ 37800 \text{ for } \circ\ \circ \end{cases}$$

$$C = \begin{cases} 5820 \text{ for } \circ\ \square \\ 3000 \text{ for } \circ\ \square \\ 1900 \text{ for } \circ\ \circ \end{cases} \qquad H = \frac{\text{Length}}{\text{Diameter}}.$$

TABLE XIX.—Table of length, in feet, of lattice bars, weight per foot of same, and weight of rivet heads.

TABLE XX.—Table of Permissible Pressures on Rollers calculated by the formula $p = \sqrt{0.135d}$ where p is the pressure per lineal inch of roller in tons of 2,000 pounds and d the diameter of roller in inches. The first vertical line gives diameters of rollers, the first horizontal line their lengths and the intermediate figures the corresponding permissible pressures.

BROOKLYN BRIDGE.

Everybody is desirous to know something about the prospect of the early completion of the bridge. In order to furnish the public with some assurance on this subject, the trustees requested an expression of opinion from Mr. Roebling, the chief engineer, and they received the following response, a copy of which accompanies the memorial to the Legislature:

BROOKLYN, March 10, 1882.

Hon. Henry C. Murphy, President Board of Trustees New York and Brooklyn Bridge:

DEAR SIR: In response to your letter of March 9, written at the request of Comptroller Campbell, I beg to assure you that the million and a quarter called for in my last estimate will be ample to do all the work enumerated in that estimate, and open the bridge for use. The item of liabilities under outstanding contracts is a fixed fact, and cannot be changed. The estimate of money for work required to complete the bridge is dependent upon the delivery of the steel, and we have Mr. Seller's promise that it will be delivered this summer. The item of materials required for the completion of the bridge and approaches, not yet contracted for, can all be had for the figures given in the detailed estimate. The elevated platforms and rope machinery are simple engineering problems, and their cost is not likely to be increased in any way above the estimates. Respectfully yours,

W. A. ROEBLING, Chief Engineer.

The following statement exhibits an approximate estimate of the total cost of the bridge, when completed, including the amount to be expended, in addition to previous expenditures and the unexpended means provided by former acts of the Legislature, viz.:

February 1, 1882, total expenditure to date...	$13,439,500.56
Cash on hand....	90,356.49
Amount claimed as due from the cities under acts of the Legislature	500,666.67
Estimated value of lands acquired and to be sold by the trustees....	200,000.00
Amount of bonds to be authorized....	1,250,000.00
Estimated total cost, exclusive of portals at terminal of the bridge....	$15,480,613.72

STATEMENT OF THE AMOUNT OF MONEY REQUIRED FOR THE COMPLETION OF THE BRIDGE, BASED ON THE REPORT OF THE CHIEF ENGINEER, FEBRUARY, 1882:

I. Estimated cost of completing the bridge and approaches:		
Liabilities on outstanding contracts for material	$565,322.32	
Estimated cost of material required for the completion of the bridge and approaches other than that contracted for.	114,670.60	
Salaries of officers and engineers and cost of labor for completing the bridge and its approaches	117,632.97	
Total....	$797,625.89	
Cash on hand February 1, 1882, and due from the cities, less liabilities for salaries and materials received in January....	553,557.39	
Amount required for completion of the bridge and approaches in addition to the money on hand and due		$244,068.50
II. Estimated cost of elevated tracks and platforms at the termini:		
1. Cost of elevated platforms, including track arrangements, roofs, waiting rooms, ticket offices, etc	$298,908.00	
2. Cost of machinery, boilers, hauling ropes, etc....	37,978.00	
3. Boiler-house....	12,000.00	
4. Rolling stock	132,000.00	
Total....	$450,886.00	
Ten per cent. for contingencies.	45,088.60	
Total....	$495,974.60	
Added by Transit Committee....	100,000.00	
Total estimated cost of elevated tracks and platforms		$595,974.60
III. Estimated cost of fitting up warehouses under the arches of the New York approach, complete for occupancy		348,184.00
IV. Price of land on Chatham street, New York, adjoining bridge property and agreed to be purchased by the trustees ..		17,500.00
Total		$1,205,727.10
Added for contingent expenses....		44,272.90
Total		$1,250,000.00

[Signed] W. A. ROEBLING, Chief Engineer.

RECENT INVENTIONS.

A novel lamp reflector for railway stations consists of making the shade of a single piece of molded glass, having the form of a truncated pyramid, the several faces of which are each provided with a bull's-eye lens.

A new appliance for railway drawbridges locks the draw in position by the act of shifting a switch to the main line, its normal position being to the siding, and it cannot be so shifted unless the bridge is in proper position in view of a lug upon the bridge which operates a locking bolt to permit the switch lock bolt to secure the bridge. The siding has an incline whereby trains will be brought to a stand, and an automatic switch at the summit of the siding to direct a runaway locomotive into a double inclined siding, where it will be brought to rest. Weighted tilting forked catch levers are arranged between the rails to catch about the axles and stop the locomotive.

A recent safety railway switch has its switch-rail shifted automatically through pivoted levers alongside the track, which are actuated by laterally adjustable bars on the pilot or cow-catcher of the locomotive. A transverse rod, to which one end of each of said levers is pivoted, slides in guide shoes having anti-friction rollers, a hand-operating lever being secured to said rod in one of the guide shoes.

A late improvement in apparatus for generating vapor from liquid hydrocarbons consists essentially of a generating chamber having an internal steam space comprising a series of vertically arranged communicating spheroidal receivers. The arrangement and advantage of these receivers is such as to cause the evaporation of the hydrocarbon flowing over them, according to their volatility—that is to say, the most volatile hydrocarbons are evaporated first and the least volatile last—and to permit the highly heated steam to attack the carbonaceous residua, and form carbonic-oxide and hydrogen gas. The steam is made to flow from the generator under sufficient pressure to carry the hydrocarbons in vaporous form to the point where they are required, and mix the vapor with an air blast to insure complete combustion.

A new device for distributing electrical energy, designed particularly for use in connection with the electric light, comprises an electric circuit divided into branches, with a continuous current generator in the undivided portion thereof. A number of electric lamps are arranged in said branches in a multiple arc, and a secondary battery is located in a branch by itself. The effect of this construction and arrangement is, that when the generator is supplying more electro-motive force than is required by the lamps the excess may develop a charging current through the secondary battery, and when the potential in the circuit falls below the normal, the secondary battery may discharge and supply a current to the lamps, reinforcing that from the generator.

Pile-drivers are now proposed to be constructed with the hammer mounted upon a turn-table turning about a hollow pivot, through which the hammer rope passes, said turn-table resting upon a laterally adjustable platform upon a car platform. The hammer-leaders are formed of T-irons, over which are riveted channel bars, and they are pivoted to the front edge of the turn-table, and are adjusted vertically through brace-frames, the lower ends of which slide on inclined guideways upon the turn-table.

A recently invented truss-bridge has a hollow, wedge-shaped box, with pockets on opposite sides to receive cased ends or chord-sections, and a bolt to adjust the parts; an eccentric on a pin as an adjustable connection of tension chords, and means for adjusting and holding it; counterpart wedges for adjusting posts to chords and braces; and girders of channel iron spaced by blocks, which also serve as sockets for floor joists.

A novel self-recording grade instrument for making sections for railway and other surveys consists of a wheeled prime-mover, which is propelled over the track to be surveyed. Another wheel of the same size, and smaller wheels, connected with a suitable framing, constitutes the carriage for holding the device. Connected with the prime-mover wheel is a small vertical worm, which drives another horizontal wheel carrying on its axis a surface wheel. Upon the latter is carried a vertical wheel or level-motor capable of traversing from the center of the surface wheel to the periphery. An adjustable swivel is in connection with the axle of the said vertical wheel, which may be adjusted by means of two slide rods, with both of which it is connected. This swivel forms the junction with another vertically suspended wheel. This last-named wheel is heavily weighted in one or more of its segments, so as to always remain in one vertical position. If the weighted wheel be moved forward or back ward relatively to the horizontal level of the carriage, the slide rods above referred to are moved backward or forward, in order to enable the machinery of which it is a part to mark the rise and fall of the ground. It follows, therefore, that any change in the level of the carriage will correspondingly affect the position of the level motor, shifting it to one side or the other of the center of the surface wheel, which will then revolve with a greater or less velocity, as it is more or less distant from the center governed by the eccentric. Connected by axles and pinions, this shifting motion is transmitted to a pencil held on a rack-wand. This rack-wand receives its motion from gearing set in motion by the prime-mover wheel, and consequently the wand will cause the pencil to mark or record horizontally right or left of the medial line of the machine, as the angle is up or down during the travel of the carriage, and so that it may act upon a sheet of paper coiled upon a bobbin, and which passing over a curved surface is received upon another similar bobbin. The paper may be graduated and its speed adjusted to any ratio with the speed of the prime-mover. F. B. BROCK.

WASHINGTON, D. C.

COST OF ELECTRIC LIGHTING AS COMPARED WITH GAS.

An American paper states that the Brush Electric Light Company receives $7,400 per annum for lighting Fourteenth street, New York, from Fourth to Fifth avenue, Fifth avenue, and Broadway from Fourteenth to Thirty-fourth street, and the latter street from Fifth avenue to Broadway. In addition, the company, under its contract, also furnishes two groups, six lights each, in Union and Madison squares respectively. The street lamps have been lighted for several months; those in the squares have been in operation for a shorter period. The illumination is said to be fairly satisfactory. The tower lights, however, are effective only upon a small area, and it is also thought that their effect will be still further impaired by the heavy foliage in summer. The total number of gas lamps which it has been possible to extinguish by the substitution of electric lamps in 430. The municipality of New York formerly paid $17.50 per lamp per annum, which is estimated to have been at the rate of about $1 per thousand cubic feet net; but it is stated that that rate was so low that the gas companies did not care about lighting the streets. The gas lights, therefore, cost the city (and probably the producer) $7,525 per annum, and are replaced by the electric light at a cost of $7,400. It is a doubtful point, however, whether the Brush Company, as in London, makes or loses money at this rate. The advertisement alone, in either city, is worth something, and it is just possible that this was taken into account in making the contract. At all events, there seems to be very little margin of difference where gas is supplied at $1 per thousand cubic feet. This, however, it should be clearly understood, is much less than the charge made to private consumers of gas in New York.—*London Architect.*

ENGINEERING NEWS.

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S. D. V. BURR. ....ASSOCIATE EDITOR.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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WE hope, in our next issue, to present a full report of the interesting meeting of the American Water-Works Association at Columbus, O., on the 14th and 15th insts. This association of the practical managers of the works for furnishing water to the people of this country is destined, if conducted with the good judgment which has been displayed so far in its organization, to be of inestimable benefit to consumers as well as furnishers of water.

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EADS' SHIP RAILWAY.

It is with extreme diffidence that we would venture to dissent from the conclusions to which our valued contemporary of the *Railroad Gazette* would seem to have arrived in his opinion as to the feasibility of this ship railway. Possibly Capt. Eads does not propose to carry his ships over the Isthmus by means of a dozen or so of the railroad tracks now in use, nor use any specified number of the present locomotives. Some time ago a twelve or fourteen-ton engine was brought upon a portion of the main road between this and Boston, and it was called, par excellence, "the big engine," nothing like it having been seen previously, and his sanity would have been questioned who should have attempted to belittle the engine by saying that he expected to see forty-ton engines running upon the same or similar roads, where, indeed, they are running now. Will any one venture to say that we have reached the limit of the capacity either of road or engine?

At a maximum speed of say 6 miles per hour, and on a straight line without curves, it is not too much to expect that engines weighing 100 tons (of 2,000 lbs.), all on the drivers, can be operated; the dimensions and character of track, rail and wheels being made to conform; nor that the bearing wheels of the ship's cradle, say 30-in. wheels, shall be capable of sustaining a weight without injury, at the limited speed named, of 6 tons (2,000 lbs.), if need be. The fact that the cast-iron wheels, found sufficiently safe and cheaply renewed by the thousand yearly for the wants of a rapid speed and traffic, should be estimated at a strength of but 7,500 lbs., is by no means an evidence that the needs of the new service cannot be met by wheels of from 600 to 800 lbs. weight, should it be thought desirable.

Capt. Eads, in his address before the Chamber of Commerce of San Francisco, Aug., 1880, says that under a cradle 350 ft. in length and borne by 12 lines of rails, each rail supporting 115 wheels, or 1,380 wheels in all, a load of 600 tons would give for each wheel but 4⅓ tons weight, and the road would suffer no greater stress than some of our heavy traffic roads. But supposing it otherwise, it will be a mere question of dollars to provide the requisite strength. In the letter from Sir Edward Reed, he very conclusively shows that from 4,000 to 6,000 tons will probably be the extreme displacement of a vast majority of the shipping seeking this passage, and it would be entirely uncalled for to provide for the few vessels of greater tonnage which may be launched for other traffic, and his experience in the operation of building and decking ships should give his opinion great weight on this point, as also on the probable weight of the supporting cradle, which for a 4,000-ton ship he estimates at 500 tons, and for a 6,000 ship at 750 tons, but we will double these weights and say for the first cradle 1,000 and the second 1,570 tons.

Capt. Eads estimates 2½ miles only of 2 per cent. grade across the Isthmus, and upon the supposition that the grades cannot be thrown together so as to leave the shorter, heavier ascent to be overcome by stationary power, which might be feasible, we will assume 100 ft. per mile grade as necessary, which therefore becomes the limit to be provided for. This leaves the resistance to be encountered on the track as the only element remaining to be fixed for an estimate of what is *possible*. Taking results of experiments of heavy freight trains on the Erie Railroad, as conducted by McCallum: That 6.5 lbs. per ton (2,000 lbs.) represents the friction of engine and tender without load, friction of loaded cars, 4½ lbs. per ton; gravity of engine and load for 100 ft. grade, additional friction of engine by other resistances than that of the friction of the cars, embracing a side wind pressure of 40 miles velocity for a surface of 350 × 40 ft., and altogether we find the resistance for a 100-ft. grade for a ship and cradle weighing 5,000 tons to be about 250,000 lbs. This is for the maximum grade, which extends but for 2½ miles.

Taking the adhesion of an engine at one-fourth its weight, and the engine weight will be 500 tons. Or, for four engines and tenders, all wheels coupled, 125 tons each say—90-ton engine and 40-ton tender—200 tons of the engine weight being included in the load as estimated. We see nothing in this so formidable as to lead us to question the entire feasibility of a project which has received the unqualified support of men of great experience in matters pertaining to naval constructions of all kinds. Our greatest fear lies in another direction, and that is, that a work which should be American, and the importance of which appears to be better appreciated abroad than at home, will be controlled by foreign capitalists to our national disgrace.

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SEWERAGE FOR THE STATE OF NEW YORK.

In ENGINEERING NEWS of Feb. 18, quoting from an article in the *Mail and Express* as to the results of the examinations abroad of the Director of the New York State Survey, and the conclusions to which he had arrived, and the recommendations which he had made, based upon the conclusions, viz., that the "combined" system of sewerage was an utter failure, wherever it had been carried out, and the "separate" system was the more preferable, we had not been favored with a copy of the Report of the gentleman referred to, and our remarks were based entirely upon the tenor of the article in the *Mail and Express*. Mr. Gardiner's Report is now before us, and we beg leave to comment more fully upon his treatment of the subject, in reference to points which had not been brought to our attention in the newspaper article referred to; but even now it would scarcely call for further notice, were it not that the recommendations of Mr. Gardiner are indorsed throughout by the State Board of Health—our highest sanitary authority.

The conflicting opinions of sanitarians on these matters have hitherto tended to unsettle the public mind to a great extent; and while looking for some one method for the proper disposal of sewage, the fact is very much lost sight of that the locality and its surroundings should control this matter to a great extent, and no engineer at the present day can be found to advocate any known method as practically applicable to all localities. And yet, recognizing the fact that the prompt removal of sewage of *all* kinds from the vicinity of dwellings is a measure of the first necessity, that method by which this essential can be effected with the least possibility of its disarrangement through the neglect of personal agents or employés is undoubtedly the best; and, putting expense out of the question, no one can have the hardihood to deny that the water carriage system does offer this advantage over any or all methods which have been proposed to this end. But in many localities this method, with all its theoretical advantages, is practically debarred; and hence we are driven of necessity to look to other means, not as the best, but as the most practicable, in such cases.

The paper referred to, however, settles all that has heretofore been a subject of doubt in this most intricate subject, and one which has been entirely misunderstood, it would seem, until now by some of the most enlightened minds of the age.

The paper is entitled "No. 42, State Board of Health of New York, Report on the Methods of Sewerage for cities and large villages in the State of New York, by James T. Gardiner, Director of the New York State Survey, Member State Board of Health."

As conducive to perspicuity, we propose to take the headings of the subject as he has treated them, *seriatim*.

In the first place, all that is said in the opening of the paper of the dangers of the cesspool and privy vault we heartily indorse, and so far as we know, modern sanitation has uniformly condemned them as fraught with mischief, and yet to this day, as in Paris, a proper system of police and inspection will mitigate the evils, which at first sight, and on theoretical principles, would seem to be almost insurmountable, and render their use under proper management not incompatable with a low death rate. The use of cesspools in some shape, removed from the house on farms or very small settlements, cannot well be avoided in the country, where an attempt to apply the alternative of the semi-barbarous pail system, would be attended with the very evils sought to be removed, and result in the house waste and sewage being scattered or disposed of in an equal or even more objectionable manner somewhere else on the premises.

After disposing of the cesspools and vaults, the first method which is taken up for consideration is the *dry removal*. Of this method, two means are alluded to, the dry earth closet, and the "pail" system. The first, for reasons stated, is no longer recommended, and as showing the uncertainty of expert testimony, we would state that no longer ago than 1870 this very dry earth closet method was advocated by the present advocate of the separate water carriage system, Col. Waring, as destined to supersede all other methods entirely, especially in villas and small settlements. Water carriage was condemned even in cities, and the dry-earth closet lauded as the system of the future, and even the manurial value of the product, now found to be worthless, was stated as one of its advantages over that of any method of water carriage. Companies were formed to manufacture the utensils; agents appointed throughout the length and breadth of the land to sing their praises and to sell the patent rights and circulate the sensational writings of its chief apostle. Ten years have sufficed to explode this fallacy, and who shall say that the next great boon which is offered in its stead shall be longer lived? The disgusting tub, cask or "pail" system is recommended for all villages and towns without public water supply. And we may say cities are included possibly, for Manchester with 500,000 inhabitants is cited as a successful example to follow.

In Manchester, he says, the "pail" is of galvanized iron of a capacity of ten gallons. "Each tub is covered with a close-fitting double lid before removal." "Beside each tub is a very simple ash sifter, from which the ashes fall to help deodorize its contents." "The tubs are removed in the daytime without offensive odor." In Rochdale, a city of 70,000 inhabitants, "the manure sells for four-fifths of the cost of its collection and preparation," etc. He admits that "from false economy or neglect, these pails may not be attended to at sufficiently frequent intervals," but adds "that the small size of the tubs puts a narrow limit and compels attention." Possibly—though we may very naturally ask—from whom? and point to the above-described process as requiring no further comment. The prime advantage of this highly-savory proceeding, it seems, is "the cheapness of the plan and the smallness of the original outlay of money and brains." We hazard the opinion that it is doubtful where the economy of brains is most manifest—in the user or the advocates of such a method.

Water Carriage, or Sewerage.—This is divided into two heads—the *combined* and the *separate* systems. So much has been written on these that we refrain from more than a brief notice of their characteristics. By the first, all sewage whatever, including excreta, house slops and street sewage, with a proportion of the rainfall, is conveyed to some remote outlet by a single channel of discharge. The separate system, on the contrary, requires a line of sewers devoted exclusively to the house sewage, while the sewage from other sources and the storm waters must have their separate lines of sewers, or, as in Memphis, trust to their getting off the surface or out of sight as they best may.

After explaining the above systems, Mr. Gardiner, big with an idea of which he delivers himself "that engineers have made the mistake of confounding sewer gas with the cause of disease, and hence their mistake in supposing that the ventilation of sewers by diluting this gas would prove effectual in weakening the sources of disease," proceeds to say, "that *no such gas as sewer gas exists* (the italics are his) *and that there is absolutely no proof that the diseases which attend the admission of sewer air into a dwelling are produced by gases*." This is a quibble, unworthy the State Board of Health. No engineer of the present day believes that gas however generated can be considered as the *source* of disease, or in itself producing disease, but that it may be the vehicle for disseminating disease germs—whatever they may be—on the principle that the gas generated by the decomposition of animal matter may be the pabulum which nourishes these lower organisms—this they undoubtedly believe, and hence that ventilation, which is dilution of this gas, is believed by them, as we supposed by physicians generally, to be a means for lessening the spread of disease, as weakening the element which is essential to its increase—in other words, sewer gas is an efficient cause, but not the final cause, of disease. Are bacteria supposed to be nourished by any of the gases known to chemists as the result of decomposition? Is it not a fact—or rather it is a fact—that in addition to the known gases of decomposition, susceptible to chemical tests, there is a something which for lack of a better name we may call organic vapor, without which none of the known gases are productive of *disease*, although, when in excess, they may kill. Sewer-air may indeed be a better name than sewer-gas; but a mere change of name will not change its properties nor its capabilities for mischief, nor the sense in which we use the word.

He says further, "that the sewer-air may bring the germs of disease into dwellings, while the foul gases of decomposition may or may not be present." This may be all very true, but there is some assumption about it, and space will not at present admit of its discussion. We would remark, however, that the attempt to weaken the value of ventilation will be a backward step in hygiene, with the accumulated evidence in support of its value, now in our possession. It seems that large sewers, being built of brick, "their porous walls furnish the favorable soil for these deadly organisms, *and the ammonia of sewage supplying the manure essential to their full development*." We might properly ask, why is it, if sewer gas be such an unmeaning word, that one of its most obvious constituents, ammonia, should be selected as the chief element for the nutrition of disease germs? "Every device," he says, "of engineering has been exhausted to keep large sewers well ventilated, but the air from them is still deadly." All this, and much more, of simple dogmatism is the prelude to his summing up in this sweeping assertion, "that from a sanitary point of view the "combined" system of sewerage is a failure" . . . . . "and those cities which have already spent large sums in completing combined sewers, must either continue to suffer from the evils of sewer poison or incur the further expense of a separate small system for carrying sewage *only*, retaining the large sewers for storm water."

The separate system then comes up for consideration, if that may be called consideration which consists merely in giving expression to a foregone conclusion, which considers the separate system not only the best for all localities, but by far the cheaper method, and as we have already gone over the same grounds repeatedly in discussing this question, and shown the fallacy of the arguments adduced in support of the separate system for all localities, and have, in addition, published in Engineering News a most thorough and exhaustive treatment of the entire subject by one who, in addition to great natural ability, has made the subject a life-time study, both here and abroad, we refer to Mr. R. Hering, of Philadelphia—we now follow this writer no further, but as his conclusions have been adopted by the State Board of Health and a ukase issued to that effect, and, so far as lies in the power of such Board, they are law—we have a word or two to offer upon this new phase of the subject.

We have a high respect for boards of health on general principles, that is to say, in the selection of the individuals composing them, and it is to be presumed that the appointing power sought for the highest possible scientific attainments in its members, coupled with such experience as to render the science of the schools of practical value, and, at the same time, for its proper exercise, in a matter of so much importance, a degree of calm, judicious and comprehensive judgment, flavored with strong common sense, which should render the individual unlikely to be captured or carried away by a craze which had plausibility enough in its inception to unsettle the better judgment of the average man; in a word, the individuals should be such marked men in the community as to render their decisions unassailable, and not open even to the suspicion of having been influenced by any individual persistency, or the weakness which not unfrequently induces a board of officers to yield for the sake of harmonious action to an active element in its midst ambitious of leading in great reforms. If our State Board of Health be thus constituted, happy are we, and what now may appear dark and mysterious in its decisions will come out brighter and brighter the more it is examined, and the more light that is shed upon it will but exhibit in a clearer view that which in our ignorance and shortsightedness we mistook for imbecility, was in truth the profundity of wisdom.

SANITARY PROTECTION.

The first annual report of the London Sanitary Protection Society discloses facts which supply ample grounds for the existence of such an association. The engineers' reports show that, of the total number of houses inspected, in 6 per cent. the drains were entirely stopped up, and all the sewage soaked into the ground under the basement of the house, there being no connection whatever with the sewer; that in about one-third the soil-pipes were leaky, allowing sewer gas to escape into the house; that in about one-third the overflow pipes from the cisterns discharged into a soil-pipe or drain. More than half the houses inspected had waste-pipes from baths or sinks connected directly with soil-pipes or drains, generally, it was true, through syphon traps; but if any of the appliances should be disused for a time, and the water in the tap dry up, those waste-pipes would provide a direct channel for sewer gas into the house. It is certainly alarming that, out of the total number of cases inspected, 6 per cent. of the houses should be absolutely pestiferous. It is the merest chance that such houses have not proved hotbeds of disease. In a much larger proportion there are defects in the general arrangements and drainage of the houses which ought to fill us with alarm. We shall not be surprised if, should the association continue long enough, the bad state of London houses will lead to an official inspection of houses in all towns. By such an inspection as that afforded by the society, the spread of typhoid fever will be in a great measure prevented. It is a satisfactory sign of the appreciation of the efforts of the society that some public buildings have already been placed in their charge with regard to their sanitary arrangements.

PERSONAL.

Mr. E. Comboul, chief engineer of the New York, Texas & Mexican Railroad, has resigned.

Mr. T. A. Hill has been appointed chief engineer of the Austin & Northwestern (N. G.) Railroad. Headquarters at Austin, Texas.

Isaac Worney, an eminent engineer, of Pittsburgh, Pa., has been appointed Superintendent of Public Works by the Citizen's Council of San Antonio, Texas.

Zachariah Allen, long one of the leading men of Rhode Island, died in Providence on Friday night, the 17th, aged 87. He had filled many important positions. At the time of his death he was president of the Rhode Island Historical Society. He wrote "The Science of Mechanics" and "The Philosophy of the Mechanics of Nature."

A dispatch dated City of Mexico, March 14, says, James Pyett, an American engineer, with six Mexicans, coming down a steep grade on a hand-car on the National Railroad, turned suddenly upon a bridge where two men were. One jumped. The car containing the others was thrown into the chasm. Pyett and three Mexicans were instantly killed. The others were fatally hurt.

G. Clinton Gardner, General Manager of the Mexican National & Texas-Mexican Railway has issued the following general order: Engineer S. T. Fuller, of the Northern Division of the Texas-Mexican Railway Company, has been appointed general superintendent and chief engineer of the Northern Division of the Mexican National Construction Company and the Mexican National Railway Company, as also general superintendent and chief engineer of the Texas-Mexican Railway. His duties as general superintendent and chief engineer will extend over all the lines of these companies north of San Luis Potosi, including the Matamoros Division. Superintendent W. W. Hungerford has been appointed superintendent of construction, and will report direct to General Superintendent and Chief Engineer Fuller, taking personal charge of the movement of trains and the track work on Lampazos Division, with such other duties as may be assigned to him. Principal Assistant Engineer E. Miller will take personal charge of location and surveys, with such construction work as may be assigned to him, reporting direct to General Superintendent and Chief Engineer Fuller.

Solomon White Roberts, a well-known civil engineer, died at Atlantic City, N. J., on the 23d. Mr. Roberts was born in Philadelphia, Aug. 3, 1811. At the age of sixteen he left school and went to Mauch Chunk, where he received a position as assistant under his uncle, Josiah White, then the superintendent of the Lehigh Coal and Navigation Company. Under Mr. White's direction, in 1827, was constructed the first railroad in Pennsylvania, extending from Summit Hill to Mauch Chunk, a distance of nine miles. In 1829 Mr. Roberts entered the service of the State as an engineer, and two years later undertook the work on the Portage Railroad.

In 1836 he entered the service of the Philadelphia & Reading Railroad, and for two years remained abroad superintending the manufacture of railroad iron. From 1838 to 1841 he was chief engineer of the Catawissa Railroad. In 1842 he was elected president of the Philadelphia, Germantown & Norristown Railroad Company, and from 1842 to 1845 he was the president of the Schuylkill Navigation Company. In 1848 he was elected to the State Assembly and secured important legislation in aid of the Pennsylvania Railroad Company, in which line he was largely interested. From 1848 to 1856 Mr. Roberts was the chief engineer of the road. He then accepted the same position on the North Pennsylvania Line and continued there until the road was merged into the Reading Railroad system.

ENGINEERS' SOCIETIES.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting on Tuesday, February 28, Mr. E. Woods, vice-president, in the chair, the paper read was on "Steel for Structures," by Mr. Ewing Matheson, M. Inst. C. E. The object of this paper was to state the present position which steel occupied, as compared with iron, as a material of construction; and to examine the reasons why, while steel was rapidly superseding iron for ships and boilers, it was so seldom used for bridges. Steel possessed the important advantage of a strength one and a-half to twice that of iron, as well as superior elasticity and ductility; and, owing to the method of manufacture, plates and bars of the usual kind could be made of steel in much larger pieces than was possible with iron, thus avoiding the numerous joints which the smaller pieces involved. The special treatment necessary for steel could soon be learned by workmen accustomed to iron, and the tools and machinery of a factory could be used for either metal. In regard to wasting by rust, sufficient time had hardly elapsed to prove positively the durability of steel as compared with iron, but at present it appeared as if the difference, if any, was in favor of steel. Because of its greater strength, structures equal to iron could be made of less weight in steel; and in regard to ships, this saving allowed a corresponding increase in cargo-carrying capacity, or a reduced immersion. In boilers, plates, whether of steel or of iron, could not conveniently be of more than a certain thickness, and the working pressure was limited accordingly; but the superior strength of steel permitted a working pressure of steam one-third greater than in boilers of iron, thus allowing a saving in the space occupied for a given power, and greater economy in fuel. In regard to girders or bridges, if strength and elasticity were assured, there was not the same necessity for the great ductility which in ships was so important to resist concussion; but the rules of the Board of Trade, which controlled railway structures in this country, allowed working strains on the parts of steel bridges based on the extremely ductile steel used for ships. That was to say, while the maximum strain allowed on iron was 5 tons per square inch of sectional area, a strain of only 6½ tons was allowed on steel. By this limitation, the engineer, in designing bridges, was unable to take full advantage of steel; and as, moreover, for various secondary reasons, the thickness of parts in a steel structure could not be reduced, in proportion to those of an iron structure, quite so much as even the permitted strains allowed, bridges of moderate span could not be made so cheaply of steel as of iron, so long as the cost of the material exceeded, as at present, that of iron in a proportion equal to that of the greater strains permitted. Until the present time, the cases in which steel had been profitably used were those in which, because of difficult transport in new countries, lightness was of great value, and those where, owing to the great length of span, the weight of the material itself, as distinct from the dead and moving load it had to carry, imposed the principal strain, a compound saving being thus afforded by the use of steel. In this way, while a saving in weight of only 12 per cent could be obtained in a bridge of 50-ft. span, a saving of 80 per cent. could be obtained in a bridge of 500-ft. span. With the present prices of iron and steel, there would be a loss by using steel in the small span and a gain by using it in the large span. But while there might be no immediate pecuniary saving by using steel, there was, owing to the very moderate strains permitted on this new material, a much greater margin of safety than in iron. Hence the question arose whether, even although the cost of steel bridges of moderate span might be greater than that of iron bridges, they should not be preferred, and their use enforced, because, if measured by units of strength and durability, as well as of money, they would be cheaper eventually.

There were several means by which the use of steel might be extended. In the first place, the experience gained during the last few years, as to the certainty of quality and the readiness with which it could be treated, had not yet spread to all concerned, especially to engineers abroad, who awaited some authoritative affirmation to set against the records of early mistakes, misapplications and failures. The proper treatment of steel had now been thoroughly investigated, and the circumstances under which the metal was damaged, by punching holes and other manipulation, were well understood. But there was also needed some ready means of verifying quality. This was far more necessary in steel than in iron, because in the latter the range within which strength might vary was only one-sixth, whereas steel had a much wider range. Again, the mere fact that iron had been rolled into shape insured a certain minimum of quality, while if steel chanced to be bad it might be one-half weaker than was wanted. An authoritative brand or hall-mark seemed necessary, if steel was to be universally accepted, and the author suggested that some mark should be adopted, as denoting quality and kind, the addition of the particular trade-mark of each maker serving as a warranty. But in order to encourage a further use of steel, the Board of Trade rules should be altered. While a certain minimum of strength and ductility might be demanded, the present limits to the maximum straining should be amended so that, instead of 6½ tons per square inch, 8 tons might be allowed, an increase amply justified by the experience acquired during the last few years. If this was done the greater demand would almost certainly have the effect of bringing the price nearer to that of iron, as had been the case with rails. The author set forth the present rules of the English Admiralty and Lloyd's in regard to steel for ships, and directed attention to the different rules of the French Admiralty, to exemplify the alterations which he proposed. As it was by means of a Royal Commission that the present strains on steel were permitted it was time that another commission should be appointed to inquire into the facts more recently acquired and to grant more liberal rules for the future. With an extension of the present limit of 6½ tons there would be such a demand as would lead to improvements in the manufacture, increase the output and reduce the price of steel. The whole calculation would then be altered, and when steel might not only be worked to 8 tons strain per square inch, but the difference in price over iron was less than it was now with 6½ tons, then, but not till then, would the era of steel structures have arrived.

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LIVERPOOL ENGINEERING SOCIETY, ROYAL INSTITUTION, COLQUITT STREET.

At a meeting of the above society held on Wednesday evening, March 1, Mr. C. S. Pain, Vice-President, in the chair, a paper on "Heating and Ventilation" was read by Mr. W. E. Mills.

The author, in introducing his subject, pointed out the necessity that existed for a scientific study of its principles and laws, as evidenced by the fact that upwards of 120,000 deaths occur annually in the United Kingdom from what may be called preventible diseases, a large proportion being from consumption, bronchitis, etc., and mainly due from neglect or ignorance of the laws of ventilation.

The earliest means of heating—viz., by a pan of charcoal, or live coals, afterward improved by being placed in a box or grate—was then described, and this arrangement with some modifications in form, but none in principle, was shown to be the ordinary household fire-grate of the present day.

Large buildings requiring special appliances for economizing and distributing the heat produced by combustion, stoves were introduced, which for heating answered well, but by consuming the oxygen of the air, destroyed the vital principle, and from a ventilating point of view were consequently inadmissible.

Stoves and fire-grates shared alike the disadvantages of being too local in their influence. Where heat was required to be conveyed to a distance, some other means of doing so than by a stove or grate was imperative. Hot water naturally suggested itself, and the "low pressure" and "high pressure" systems were described. Neither were to be taken as satisfactory, unless provision were made for introducing fresh air under the pipes, so as to fulfill the requirements of proper ventilation.

The author pointed out that it was a great fallacy to suppose that air to be *fresh* must of necessity be *cold*. All air admitted to a room or building should first be moderately warmed. This could be effected by means of ventilating grates, the principle of which consisted of a chamber formed behind the ordinary fire-grate, supplied with air from the exterior of the building, which, after being warmed, was delivered into the apartment. The principal kinds were the Galton, the Longden, the Boyd and the Mancher, each set of which were briefly described.

Gas stoves the author condemned, as, although convenient, the fumes given off were very deleterious, and a large amount of gas was consumed for very little effective result.

The system patented by Mr. Lewis W. Leeds, of Philadelphia, was next described. Steam was employed as the heating medium, supplied to coils or radiators, of specially formed pipes, the theory being that the proper way to warm a room was by radiation from the floor and walls.

With regard to ventilation, the author showed that it was necessary to change the air of a room several times in each hour, according to the number of occupants, gaslights, etc., allowing for each person 900 cubic feet per hour, for a gaslight 480, and for a fireplace 48,000.

The cause of draughts was then explained, the remedy being to admit a copious supply of fresh air at the lower part of the room, and draw off the foul and vitiated air at the upper.

Pott's Ventilating Cornice and Tobin's Vertical Tubes were then treated of, and their advantages and disadvantages compared.

The author concluded his paper with a few rules as to the proportion of inlet and outlet for ventilating shafts, the amount of radiation from hot-water pipes, and the cooling effect exerted by windows.

An interesting discussion followed the reading of the paper. The Vice-President announced that at the next meeting of the Society, to be held on Wednesday, March 15, a paper on "Paper Machinery," would be read.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 91.

CCXLVI.—SALEM, OR.

Salem, Oregon, in lat. 44° 56′ N., long. 123° W., is on the east bank of the Willamette River. It possesses a valuable water-power from Mill Creek, which empties into the river near this point.

Settled in 1840, it was incorporated in 1846. Water-works were built by a private company, after the plans and under the superintendence of W. F. Boothby, taking the water from the Willamette River and pumping it 87 ft. by a Blake pump of 18-in. steam and 12-in. water cylinder of 24-in. stroke into a reservoir of stone and timber holding 180,000 gallons.

Distribution is by 6 miles of cast-iron pipe of 6-in. to 8-in. diameter, with 35 fire hydrants, 25 gates and 250 taps. The town pays $1,500 per year for use of hydrants. Service pipes are of galvanized iron. The population in 1880 was 5,000. The daily consumption is 360,000 gallons.

The capital stock is $90,000. The works have cost $50,676.11, including purchase of water-power and opposition works in 1881. There is no debt. The gross receipts have been $54,971.18. The expenses in 1880 were $3,000.92 and the receipts $5,595.11.

W. F. Boothby is President and David Allen Secretary of the Company.

CCXLVII.—PIOCHE.

Pioche, Nevada, is in lat. 37° 50′ N., long. 114° 30′ W., in a cañon of the Cordilleras, 7,000 ft. above sea level. Was settled in 1869.

Water-works were built by a private company in 1872, after plans of George Coffee, taking water from springs and catching it in wooden tanks holding 200,000 gallons, 312 ft. above the town.

Distribution is by sheet-iron pipe, double riveted and coated with asphalte, of which 8 miles are laid, of from 8 to 5-in. diameter, with 20 fire hydrants and 45 taps. The town does not pay for use of water. Service pipes are of gas pipe. The population is about 900 and the daily consumption 10,000 gallons. The works cost $150,000. No further financial statements are given.

R. H. Elam is the Superintendent.

CCXLVIII.—PORT BYRON.

Port Byron, N. Y., in lat. 43° 2′ N., long. 76° 40′ W., at the outlet of Owasco Lake, is in the valley of the Owasco, with hills to east and west from 100 to 75 ft. high.

Settled in 1797, it was incorporated as a village in 1837. Water-works were built by the village in 1872 for fire purposes only, taking the supply from the lake, and pumping by water-power through a 4-in. pipe into a reservoir 150 by 55 ft. and 12 ft. deep, excavated in clay and without lining, and 175 ft. above the village.

A 6-in. pipe connects with the force main near the pump, and extends through the main street. A 4-in. pipe from the reservoir passes through the streets on the west side.

The pipes are of cast iron. About 3 miles are in use, with 24 fire hydrants, 3 gates and 26 taps. The water is not used for drinking or household purposes.

The population in 1880 was 1,250. The consumption is not known. The works cost $10,000, and there is a bonded debt of $8,000 at 6 per cent. interest. Further financial statements are not given.

Charles M. Storms is Water Commissioner.

CCXLIX.—BIG RAPIDS.

Big Rapids, Michigan, in lat. 43° 45 N., long. 85° 45′ W., is on the Muskegan River, on nearly level ground, the greatest difference of elevation being 35 ft.

It was settled in 1860. Water-works were built by the town in 1871. The supply is taken from the river through a gravel filter crib and pumped directly into the mains by a Holly engine and pumps erected in 1871, and two Blake pumps of 20-in. steam and 16-in. water cylinders, with 24-in. stroke, erected in 1880. The ordinary pressure is 65 lbs., and the fire pressure 100 lbs.

Distribution was at first by wooden pipe, which was unsatisfactory, and was replaced by cast-iron pipe, of which 3¼ miles are in use of from 8-in. to 4-in. diameter, with 25 hydrants, 4 gates and 209 taps. Service pipes are of lead.

The population in 1880 was 3,750. The daily consumption in 1881 was 264,000 gallons.

The works have cost $80,000. Further financial statistics are not given.

George H. Lincoln is the Superintendent.

CCL.—NEW BRUNSWICK.

New Brunswick, New Jersey, in lat. 40° 49′ N., long. 70° 40′ W., is on the Raritan River. The crest of a red shale bluff along the river recedes at the site of the city, forming a gently sloping amphitheatre of about a mile in diameter.

The city was incorporated in 1784. Water-works were built by the city in 1866 after plans of E. Willard Smith, C. E., and under the superintendence of Thomas N. Doughty, C. E., taking the supply from Lawrence's Brook, a stream south of the city, with 48 square miles water-shed. A stone dam 15 ft. high and 184 ft. long creates an impounding reservoir and also furnishes power to a 54-in. American turbine wheel, which drives a 12-in. pump which lifts the water 130 ft. to the distributing reservoir built in excavation and embankment, with two basins each 300 ft. square and 15 ft. deep. A Selden direct acting steam pump with 36-in. steam cylinder and 22-in. plunger has since been added.

Distribution is by wrough-iron and cement pipe and some cast-iron. Twenty miles are in use of from 16 to 4-in. diameter, with 166 fire hydrants, 209 gates, 1,250 taps and 59 meters.

The city contributes $50 per year for each hydrant out of general taxation. Service pipes are of lead and of galvanized iron. The population in 1880 was 17,167 and the daily consumption 1,264,000 gallons.

The works have cost $440,000, and the gross receipts to Dec. 31, 1881, had been $283,454.66.

The expenses in 1880 were $14,901.59, and the receipts $42,754.85. The debt is not given.

The works are managed by a board of water commissioners. M. N. Oviatt was Superintendent prior to January, 1882. A. J. Jones, the Treasurer since 1873, is now Superintendent also.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is acknowledged with thanks: From B. E. Lehman, superintendent, statistics and water rates of the water-works of South Bethleham, Penna. From O. R. Tyler, superintendent, statistics of the water-works of Torrington, Conn. From A. J. Jones, superintendent, statistics of the water-works of New Brunswick, N. J. From W. H. Glore, superintendent, statistices of Covington (Ky.) water-works. From Fred E. Hoyt, superintendent and secretary, ninth annual report of East Saginaw (Mich.) water commissioners. From Edwin Darling, superintendent, second annual report of Pawtucket (R. I.) water commissioners. From F. W. Lougee, secretary, statistics and rates of the Petaluma (Cal.) Water-works Co. From C. E. Judson, superintendent and engineer, statistics of the Scranton (Pa.) Water-works Co. From M. Coryell, superintendent, fifth report of Lambertville (N. J.) Water Co. From Robert K. Martin, chief engineer, report of Baltimore water department for 1881. From Louis Le Sage, superintendent, report of the Montreal Water-works for 1881. From Welton & Bonnett, civil engineers, fifteenth report of the Waterbury (Conn.) water commissioners. From A. L. Tompkins, statistics of the water-works of Le Roy, N. Y. From W. S. Bush, superintendent, statistics and water rates of the water-works of Westfield, Mass. From the water commissioners, statistics of the water-works of New Britain, Conn. From W. F. McCue, superintendent, statistics and water rates of the water-works of Ottumwa, Ia. From James B. Simes, president, statistics of the water-works of Downingtown, Pa. From S. S. Graves, superintendent, statistics of the water-works of Geneva, N. Y. From W. E. McClintock, city engineer, report of the city engineer and superintendent of sewers for 1881 of Chelsea, Mass.

CORRECTIONS.—March 11, p. 84, *Middletown*, Conn. The drainage area of the reservoir is 1½ sq. m. The filter wall is a double wall of *stone* filled in with small stone and gravel. March 18, p. 91, *St. Charles*, Mo. The cost of the works *was* $160,000, *not* $80,000 *as erroneously published.*

The circular sent to Tonawanda, N. Y., being returned unclaimed, it is supposed that there are no water-works there.

CONGRESSIONAL BILL ABOUT BRIDGES OVER NAVIGABLE STREAMS.

The committee of the Merchants' Exchange of St. Louis, to whom was referred the subject of bridges across the Ohio River, has returned a report to the Board of Directors. The committee conferred with C. Shaler Smith, C. E., and together a bill was adopted covering all essential points. The committee urged the immediate adoption of the bill as the sentiment of the Merchants' Exchange, and that as the subject is now prominently before Congress, and there is known to be at least eight or ten bridge bills asking charters for bridges across navigable streams of the West at the present time, they would suggest the importance of immediate action.

From the St. Louis *Globe-Democrat* we take the following synopsis of the bill:

The bill provides that in all low bridges with draw-spans across the Mississippi, Missouri and Illinois rivers there shall be one protecting pier of masonry, crib-work or piling, extending from the upper end of the pivot pier, or one of the rest piers of the draw or pivot span, up-stream for the distance of 1,000 feet from the center line of the bridge, or such other distance as may be determined by the Board of Engineers created here in this act; and which protection pier shall be properly arranged with ring-bolts and fender planking, so as to enable boats to tie up alongside of it and drop down through the draw openings at such times as it may be dangerous to attempt the passage of the draw when under headway.

A second pivot-span is required in all bridges located near a city or harbor, to facilitate the passage of craft tied to the banks, and it is provided "that the piers of all spans shall be built parallel with the current of the river at that stage of water which is most important for navigation, and that rip-rapping or other protection for imperfect foundations, which will materially lessen the required water way, will not be permitted in the channel ways of the high spans or of the draw openings.

"That in case the approaches to draw-span openings, channel-shafts, or raft passages in bridges authorized by this act are found to be dangerous or difficult of access by any important class of river traffic, the Secretary of War may, upon the recommendation of a Board of Engineers, order the construction of such sheer booms as will obviate the difficulty mentioned; which sheer booms shall be paid for by the parties owning, controlling or operating the said bridge.

"That all high bridges over the Missouri River above the mouth of the Osage River shall have two or more channel-spans located and having not less than 300 ft. clear width of channel way each; and that all low bridges in the same section shall have openings giving 160 ft. clear channel way in each opening.

"That all low bridges hereafter built over the Mississippi River, between the mouth of the Illinois River and a point eight miles above the Eads bridge over the Mississippi River at St. Louis, Mo., shall be located as prescribed in the act, except that they shall have at least one draw or pivot-span opening of not less than 400 ft. clear channel way, which shall be located over that channel of the river which is most convenient and accessible to boats with tows at all stages of water; and in case this location of the said draw or pivot-span does not bring an opening near the shore, then there shall be an additional draw or pivot-span provided elsewhere for the passage of single boats, which said draw or pivot-span shall have at least one opening of not less than 200 ft. clear channel way. Also, that all fixed spans between the shore lines at the medium stage of water shall be 300 ft. or more in length; and that the clear head-room under such spans shall not be less than 10 ft. at highest water."

The other provisions of the act prescribe high bridges, with two channel-spans of not less than 500 ft. clear channel on the Mississippi above the Eads bridge and to the mouth of the Ohio. Below the Ohio three channel-spans of 500 ft. each are required, and, "in addition to the channel-spans prescribed, there shall also be a draw or pivot-span, having at least one opening of 200 ft. clear channel way, located over a good high-water channel, easily accessible by boats at all stages of water over 20 ft. above low water."

In the Illinois River, above Peoria, the channel way is placed at 300 ft., and that whenever it is possible all bridges shall be located over straight reaches, and not less than 3,000 ft. from the up-stream end of the reach.

Companies intending to locate bridges are requested to give two weeks' notice in papers circulating extensively in the contiguous country. Parties owning bridges will also have to maintain, besides the usual lights, a bulletin conspicuously posted giving the depth of water in the channel in letters not less than 2 ft. high. High bridges over the Missouri below the Osage are required to have 3 spans of 300 ft. clear; low bridges over the Missouri below the Osage two openings of 200 ft. clear; high bridges on the Mississippi above Keokuk 3 channel-spans of 300 ft. clear, and low bridges 2 channel-spans of 200 ft. clear.

CORRESPONDENCE.

RADIUS OF GYRATION.

NEW HAVEN, March 18, 1882.

EDITOR ENGINEERING NEWS:

I am sorry that anything I have written should have been interpreted as reflecting upon any class of men, especially upon a class so worthy of admiration and respect, for character and achievements, as the "practical" engineers of America—a class to which, if I am not mistaken, Mr. Editor, you are yourself a worthy ornament. I meant no offense, either to them or to you. I may perhaps be pardoned for thinking that one who could give such shrewd hits would perhaps take in good part as shrewd a "counter," even though it might excite the circulation. I scarcely think, even now, that I was mistaken.

Perhaps the chief difficulty, at least in this part of our discussion, lies in the mutual understanding of the term we use. I speak of the "practical" man, and you speak of the "would-be scientist" in equal terms of reprobation, and, perhaps, we may both be right. Words sometimes get twisted from their original meaning, as your definitions of "wiseacre" show. That, as you say, has a primary meaning which has all but disappeared, while the later and offensive signification remains. So with "practical" man. It is susceptible in common parlance, just now, of two widely different interpretations.

I think I am as little capable of underestimating the "practical" engineer, using the word in its best sense, as you are of underestimating the "theorist," using this word also in its best sense. I certainly am incapable of thinking or speaking slightingly of any honest and *tolerant* class of men. But a spirit of intolerance in any class is reprehensible wherever found, and it was only to such that my remarks were directed.

Few need be told to-day, that the mathematics are only an aid to the reasoning faculties, enabling one to follow out to perfectly logical consequences a train of reasoning which would otherwise elude the grasp of the best trained mind. That they are an instrument only—a means to an end—and that guiding intelligence and reason must ever control the mechanism. "Theory" is thus only the best reasoning of which we are capable, by the use of all those aids which advance in mathematical knowledge has given us, and it should always be just as true as its *data*—neither more nor less. "Practice," when worthy of the name, should always be based upon much reason, whether with or without these mathematical aids, and really differs in fact, as we find it, only in that it does not generally make such use as it might of such aids, or to such an extent as it might. Hence if we are to make any distinction at all, we may say that in general it is not *always* as true as its *data*.

This, in most cases, cannot be helped, because the problems the practical engineer is called upon to solve cannot always be subjected to strict mathematical analysis.

In the validity of the *data* assumed lies then the strength of both, and the only valid reason for any popular distinction between them. Practice built up upon false *data* is only poor theory, and theory, based upon false facts, leads to bad practice. The "practical" engineer, then, is properly distinguished from the "theoretical," if at all, not by his deficiency in analysis, but by the superior accuracy of his *data*, drawn, as they are, from personal experience, and by his superior comprehension of the practical bearings of any given problem. Such a man, it is true, is often found to be deficient in his logical methods, hence the popular distinction.

The "theoretical" engineer, on the other hand, although possessed of superior accuracy in his logical methods, is too often handicapped by the lack of that personal experience necessary for a proper comprehension of the data essential to a given problem. He builds upon the experience of others. The *constructive feeling* of an experienced engineer is often more valuable than his most elaborate investigations.

Now, perhaps in reality we cannot draw such a sharp and clear dividing line as this. The two classes are not so distinct, but merge into each other. Many "theorists" have large practical experience, and many "practical" engineers have considerable mathematical facility. The work of our technical and scientific institutions tends every year to render such distinctions less and less apparent and valid. It will be a happy day for all of us when such distinctions cease to exist at all.

But every "theorist" worthy of the name has learned at least one lesson, and learned it very thoroughly too, viz.: that first assumptions and data must be scrutinized very closely, before he sets the mathematical machine at work; and that he can never afford to forget that every result it grinds out is, after all, based upon an "*if*." If he puts in error, he cannot expect to get out truth.

I think also, that every "practical" man has had good reason to remember that *a formula only holds good under the same practical conditions as those assumed in its development*, and that it can never be safely used except by one who thoroughly appreciates the premises upon which it is based and the method by which it is obtained.

But, Mr. Editor, I think you will agree with me that there are "wiseacres," both young and old, to be found in all professions, not excepting that of engineering; and these "wiseacres" are both "theoretical" and "practical." The intelligent engineer distrusts and dislikes both. You will also, I think, agree that there is, however much we may deplore it, a certain class, to whom the use of "x" and "y" is only mysterious jugglery, to be distrusted; who regard as "wiseacres," in the bad sense of the term, all who use mysterious symbols which they do not understand. I may do you an injustice, but it seems to me that the close of your article in last week's issue is an appeal to the prejudices of just this class. If these men were to see a page of Greek they would admit it might have meaning for those who can read, but when they see a page of mathematical symbols they suspect—what? They could hardly tell; but "why if there is anything there, can it not be put in simple words." Of course it is useless to tell them that the results *are* put into "simple words," and that they themselves use them, often without knowing their indebtedness. To tell them that to write out the whole in "simple words" would involve the best mind in confusion, is to tell them what they cannot understan any more than they could read the Greek page. So they subside into settled distrust and jealousy, really thinking there is a favored class of men who try to air their acquisitions by burying simple facts under heaps of "mathematical rubbish;" charlatans in fact. A veritable battle of "town and gown."

It is but natural there should be many such men in a pursuit which has only of late years been able to class itself as a "learned profession." There will be naturally less of them in the future. Still, it seemed to me that your remarks upon the subject of "*radius of gyration*" were not calculated to reduce the number of this class, and however good your remarks may have been in themselves, they were not suggested properly by the text. That you should make such use of it seems to me to call for notice.

As I understand the question, in view of your last reply, your position is this:

The edition of Rankine you consulted (1864) does not mention radius of gyration in connection with columns. But it does appear in later editions and works by that author. This you give us to understand is mainly in order to furnish *mathematical recreation* to the Glasgow students! Is this fair to Rankine or to the question? And what is its effect on the class I have alluded to?

I find nothing more in your reply which touches the question at issue at all—omitting various "digs" at "*Young America*" and (I suppose) your humble servant, which I trust will be taken by both in very good part, and only call forth wrath from those who find the remarks to "fit"—except toward the close. Here you make the very positive assertion that the use of r^2 isn't a bit better pratically than that of d^2.

Now perhaps you know quite as well as I do that assertion is not proof. I think the use of r^2 *is* better and I *gave my reasons*. I showed also how d^2 comes to be used, and when it is proper to use it and when not to use it. I did not give the mathematical reasoning, but am ready to furnish it, of course, if desired. I showed that you were really taking a *special case* and applying it generally.

You reply in substance: "Rankine isn't a 'wiseacre,' his old '64 edition doesn't mention r^2 at all, and I don't believe r^2 is any good, anyhow."

Now, Mr. Editor, this isn't sound, and any amount of disquisition upon related and non-related topics, including calculus, fluxions, quaternions and quotations from Huxley can't make it so.

You say d^2 will give as "reliable results as any other method." Now, if I may venture again to differ from you without making any pretensions to "vast knowledge," I would say that this *is not so*. At least my calculations do not justify the remark, and I am willing to compare them with yours, and more than willing to be corrected. It is, of course, a question of mere calculation and comparison, and I find that the substitution of d for r in Gordon's formula *does* make considerable practical difference. Moreover, our best practical engineers do not seem to agree with you on this point. In the specifications of the *N. Y., Pen a. & O.*, the *Cincinnati Southern*, the *Louisville & Nashville*, and in the pocket-book of *Carnegie Bros.*, we find r^2 specified, and I suppose we may infer it is good for something. I pick up the papers referred to as they come to hand on my table. I suppose I could with little trouble, if I had time, give you a full column of such references.

Does all this show anything? Or are we all wrong and has it been reserved for you to find out? Do you really think that all these men, including as they do the best bridge engineers of this or any country, are all united in the absurd use of an unnecessary and "complex" quantity which has no real practical utility whatever, just to "show how smart they are," and that it has been reserved for you to show by a casual glance at an antiquated edition of Rankine that they are all wrong and that Rankine himself, like some editors, having once written a thing down "just so," couldn't possibly change it? If so, will you please give us the method by which you arrive at your conclusion, that we may all be convinced?

If not, might I not, had I not forsworn all jocularity, refer to your own definition of a "wiseacre," and ask you, in your own interest, to revise it? For, surely, what constitutes "undue pretension to wisdom," if not the authoritative announcement of conclusions which one cannot sustain? Might I not also ask whether the "complacency" of which you speak is entirely confined to *young America?*

Finally, Mr. Editor, I make no pretensions to "vast knowledge" on this or any other subject, nor have I ever made such pretensions. I have simply done as you yourself did in the first instance, viz., consulted the same authority as yourself (though, as it appears, in a later edition) and have substantiated Rankine's conclusions by those of others, as well as by mathematical analysis, so far as it goes in this question. If the result does not agree with your entirely unsustained opinion, I cannot help it. I must leave it for your readers to decide; and while I regret that my remarks have seemed offensive, I cannot feel that they were entirely uncalled for.

I have, in common with yourself, as much amused unconcern, and, I hope, at least as much charity for the "complacent" enthusiasm and the "refreshing" conceit of "Young America" as yourself. For, after all, these are the natural failings of youth, and time will bring its remedy. But for that intolerance, born of ignorance, which is common to old and young alike, which assumes that what one doesn't know isn't worth knowing, I have not so much. It was against this, and not against yourself or any class of men, I directed my remarks. They seemed to me then, at least, as appropriate as those remarks of yours, which certainly appeared to me calculated to fortify just such intolerance, and which, however good in themselves, the text of "radius of gyration" certainly did not warrant.

Yours very truly,

A. J. Du Bois,

Prof. Eng. Sheffield Scientific School of Yale College.

[We give place with great pleasure to the above under the heading of "Radius of Gyration," from the accomplished professor of engineering in the Sheffield Scientific School of New Haven—not as determining beyond controversy whether the diameter of the least circle within the boundary lines of a given section of a column is a less reliable factor for application in Gordon's formula than the radius of the circle of gyration as proposed by Rankine, but as an able article explanatory of the grounds of difference between the methods of two classes of engineers, each indebted to the other, but more or less indisposed to acknowledge the indebtedness. The harmonious working of the two in a common field is a consummation most devoutly to be wished. The article is commended to our readers as fairly supplementary to our own on Applied Mathematics in the News of the 18th inst. We take exception to but one paragraph in the above, wherein the writer alludes to a seeming appeal on our part to the readily excited prejudices of a class of which we had constituted ourselves the spokesman. He does us scant justice in admitting the possibility of having mistaken our purpose. The closing lines of his own article in No. 9 of the News was with a sneer, not more obviously pointing to a class, in our opinion, than to an individual who has a wholesome horror of remaining long in debt to any one for compliments.—Ed.]

STADIA SURVEYING.

St. Louis, Mo., March 15, 1882.

Editor Engineering News:

There have recently appeared in your valuable paper two articles on "Stadia Surveying," which I have read with a great deal of interest. The stadia does not occupy the place in general surveys that it deserves, and anything that can be said which will bring it into more general use will certainly be a great benefit to the profession.

Attention is called to several statements in these articles which are apt to mislead the novice in stadia work.

While the stadia is the best instrument to use in all topographical work, as well as in many preliminary surveys, it is not claimed that it is strictly accurate, but the errors introduced by its use are so small that they may safely be ignored in work of the character mentioned. It can often be used with a greater degree of accuracy than the chain, and sometimes when chaining is entirely impracticable.

But encumber the stadia with sliding targets, sights to aid in holding it perpendicular to the line of sight, or plumb bobs and watch levels to insure its being plumb, microscopic divisions as a fancied aid in reading the distances closely, and constants, to apply to all readings, and you have almost entirely shorn it of its utility.

On the U. S. Lake Survey and also on the survey of the Mississippi River under the Mississippi River Commission, it has been found by long experience that the best rod for general use is made of well-seasoned pine, is 5 in. wide and 14 ft. long. They are marked as in figure 1 of Mr. Allen's article. The rod is held vertically. In graduating the rod, it has been the custom to distribute the quantity due to $(c + f)$. The space on the rod corresponding to this distance equals about 0.1 in. and is not appreciable at all with the ordinary telescope at a distance of 300 meters, except under unusually good atmospheric conditions.

It is evident, then, that the errors introduced by this method, in the average readings, are too small to even remotely affect the result.

To obviate this supposed difficulty it is suggested that the rod be so graduated that the correct distance will be given by adding a constant to the reading. This is, however, but another approximation, and is true only where the reading is over a level line. When the line is inclined, the true correction will be $(c + f) \times$ cos. vertical angle.

In the reduction of the work on the surveys above mentioned, the graphical method was long since discarded for tables published by the U. S. Engineer Department. The latter have the advantage of being accurate, and as the quantities are computed correctly, once for all, they are free from the accidental errors so liable to creep into individual computations. They are also much more expeditious than the graphical method. As for "the labor they entail," it may be said that in the surveys mentioned it is customary to have a recorder, who is usually selected from the more intelligent axemen, who records the field notes and has ample time to take out of the tables the elevations of all points given by three stadia men.

In general topographical work the use of targets, and also the plan of holding the rod perpendicular to the line of sight, are both impracticable for several reasons. The rod-man is frequently down in a hollow, behind a ridge or in the woods, where he cannot see the transit man. Many times, in order to have the rod seen, he is obliged to stand on a fence or a stump, and then hold the rod as high as he can. At other times grass, field vegetation, brush, etc., obscure the lower part of the rod, and in the woods it often happens that but small spots of the rod can be seen. It is evident that in such cases holding rod perpendicular to line of sight or manipulating targets are both out of the question. There is no doubt that under especially favorable circumstances, and where greater accuracy is required, targets could be used; but it would be at the sacrifice of considerable time. Holding the rod perpendicular to the line of sight has no advantage to recommend it.

J. A. Ockerson.

THE METRIC SYSTEM.

Boston, March 20.

Editor Engineering News:

The three fundamental principles from which the entire series of decimal weights, measures and coins are derived, have been stated in the first article upon the standard metric chain, and their application to their linear measure was explained in detail.

These principles, which have been called the principles of doubles and halves, are very imperfectly understood, although we have a decimal currency; indeed they are frequently overlooked in elementary treatises upon the metric system itself. It seems proper, therefore, to explain the application of these principles to weights, capacity, measures and coins in order that the simplicity of the decimal system may be more perfectly appreciated.

In common with the measures of length, every measure derived from these principles, whether of weight, capacity, or value, possesses the valuable property that every smaller metric unit of its class is an aliquot part of it, while it is itself an aliquot part of every larger metric unit. Weights, capacity, measures and coins, however, are used in sets, embracing that portion of the entire series best adapted to the purpose in view. A set based upon the principles of doubles and halves possesses some peculiar and valuable properties which have not been alluded to in these articles, and which may be illustrated with weights.

With the units, their doubles and halves, we have the series,

1g., 2g., 5g., 10g., 20g., 50g., etc., comprising the prime factors of 10, and their decimal multiples.

With a 1, two 2s and a 5 we can weigh any individual number of units from 1 to 10 inclusive; adding two 10s, a 20 and a 50, we can weigh any number from 1 to 100 inclusive; adding to these two 100s, a 200 and a 500, we can weigh any number from 1 to 1,000 inclusive, and so on.

We have used in making up this set, the *fewest different kinds* of weights, the 1, 2 and 5 of each denomination; we have employed the *smallest possible number of pieces*, four in each denomination; and the entire set is made up with the *least aggregate weight*, the total being just double the largest weight in the set.

A little reflection will show that the use of other kinds of weights, either in place of the 2 and 5 or in connection with them, will cause a loss of simplicity and convenience.

Sets of capacity measures, also, are composed of the 1, 2 and 5 of each denomination. They do not, however, contain duplicates, it being simpler to use the same measure when a repetition is necessary.

The principles of doubles and halves have been very imperfectly applied to the coins of the United States. This is one reason why these principles are so imperfectly appreciated in this country. The French coins comprise the 1, 2 and 5 of each denomination. The series of U. S. coins is complicated by the introduction of the 3-cent piece, the 25-cent piece and coins of 2½ and 3 dollars. The 2-dollar piece has never been issued.

The great convenience of a set of coins based upon the principle of doubles and halves is illustrated in our paper bills, with which any number of dollars can be made up with the fewest different denominations and the fewest number of bills. When people understand that money can be counted with greater convenience by using only 1s, 2s and 5s, and their decimal multiples, the 20-cent piece will be asked for in preference to the quarter.

This latter coin has retained a strong hold upon the popular mind, because so many articles in common use have been given a price to correspond with it. A moment's consideration of the fact that 25 is only divisible by 5, without a remainder, while 20 is divisible by 2, 4, 5 and 10, will show that the 20-cent piece is best adapted to the details of trade. Were it not for long-established habits, the 25-cent piece would be found as inconvenient a coin as a 2½-cent piece, or the 2½-dollar piece, for the former is merely 2½ dimes.

Enough has been said to show that the *doubles* and *halves* are required by the law of numbers; that is, that in making up 10s, of which the whole decimal system consists, 1s, 2s and 5s are the only numbers that can be used without sacrificing convenience and simplicity.

With one principle governing every class of measures, of length, capacity, weight and value, a measure or weight is furnished corresponding with each coin, and with its fractional parts, reducing the labor of computing prices, or of computing the quantities corresponding to a given price, to the least possible amount.

The metric system furnishes a single series of capacity measures, from the centiliter to the kiloliter, or from 1 to 100,000, each one of which may be exactly expressed in terms of the cubes of the linear measures, the kiloliter being the cubic meter, the liter being the cubic decimeter, etc.

This single series is used for *all commodities, liquid or dry*, thereby abolishing the confusion and incentive to fraud caused by having several measures called by the same name, as is now the case with the quart.

The metric system likewise furnishes a single series of weights, from the milligram to the ton, or from *one to one thousand millions*, each one of which is the weight of the distilled water contained in a corresponding capacity measure, under fixed conditions of temperature and pressure, the ton being the contents of the kiloliter or cubic meter, the kilogram, of the liter or cubic decimeter, etc.

This single series is used in weighing *all substances, solid or fluid*, thereby abolishing the inconsistencies arising from the use of several incongruous systems of weights, such as the avoirdupois and Troy, with which the apparent paradox, that a *pound* of feathers is *heavier* than a pound of gold, while an *ounce* of feathers is *lighter* than an ounce of gold, becomes an actual fact.

The entire system may be stated in a single paragraph:

Measure all lengths in meters, all capacities in liters, all weights in grams, using decimal fractions only, and saying deci for tenth, centi for hundredth, milli for thousandth, deka for ten, hekto for hundred, kilo for thousand, and myria for ten thousand. Surfaces and volumes are measured by the squares and cubes of the measures of length. The are, the unit of land measure, is merely another name for the square dekameter. It has one multiple, the hektor, and one submultiple, the centar; the former being the square hektometer and the latter the square meter. Similarly the stere, the unit for measuring firewood, is merely another name for the cubic meter. It has one multiple the dekastere, and one submultiple, the decistere. The terms quintal and ton are sometimes used to express 100 kilograms and 1,000 kilograms respectively. The word *ar* is derived from *area*. *Stere* is derived from the Greek *stereos*, a solid, but is rarely used, being confined to the measurement of firewood.

There are no complex tables, no complicated relations. With the meter, every possible dimension can be measured, whether of length, surface, or volume: with the liter, every possible capacity:

with the gram, every possible weight. The single paragraph above takes the place of compound or denominate numbers in our arithmetics, and conjointly with the decimal character of the system effects an immense economy in the education of the young. The gain in commercial computations is much more important, for a single operation gives an absolutely accurate result, where the common system requires several complex operations to get an answer which is often but an approximation.

The metric system, by which so much is accomplished, has already been adopted by *thirty* different countries, including some of the most important nations on the globe. In twenty-eight of them its use is obligatory by law. In several, like Germany and France, there are penalties for using any other measures; in others, as in the South American states, in Turkey and in Egypt, the law is imperfectly enforced among the people, but the system is employed in the custom-houses and other business of the governments.

In Sweden its use becomes obligatory in 1883. In British India the compulsory enforcement of the law is left to the discretion of the local governments.

The use of the metric system is permissive in Great Britain, the British Colonies and the United States of America.

Such is the remarkable record of the first ninety years of the history of this system.

With the commencement of active railroad construction in Mexico, the metric system ceased to be simply a matter of sentiment to the engineering profession, and became an affair of practical importance and necessity. Such it will continue so long as the services of engineers shall be required in that country.

Every engineer must, therefore, feel the necessity of becoming familiar with the best methods of using it in actual practice, and it has been the purpose of the writer to furnish, in this series of articles, accurate and reliable information which may assist those who may not have access to the best metric literature, in selecting and using the best implements and methods.

CHARLES H. SWAN, C. E.,
Chairman Committee on Manufacturers,
American Metric Bureau.

MAXIMUM STRESSES.

FAYETTEVILLE, Ark., March 15, 1882.

EDITOR ENGINEERING NEWS:

The following formulæ show the maximum stresses produced in a piece under the action of both a direct force and a transverse load;

Let P = maximum pull in the piece.
P' = minimum pull when loaded transversely.
M = maximum bending moment.
A = area, and I = moment of inertia of cross-section.
e = dist. of line of action of direct pull, above the neutral axis.
t = dist. of extreme tensile fiber from neutral axis.
t' = dist. of extreme compressive fiber from neutral axis.

Then the maximum stress per sq. in. in the bottom flange is evidently

$$\frac{P}{A}+\frac{Mt}{I}-\frac{Pet}{I},$$

and in top flange

$$\frac{P'}{A}-\frac{Mt'}{I}+\frac{Pet'}{I}$$

The required areas can be found by trials and approximations.

The method of W. H. Burrall (in ENGINEERING NEWS of March 11, 1882) will give results in agreement with this formula, provided that (1) the lever arm of the addition to the bottom flange is taken, as the distance between the centers of gyration of the flanges, about the neutral axis of the increased section, the web being taken into account in finding the centers of gyration; and (2) that the moment due to eccentricity of the direct force, with respect to the neutral axis, is taken into account; the direct force being assumed to act along the neutral axis of the original section. This may be allowable in a pin-connected member, where the point of application can be located with some approach to accuracy, but in the riveted girder under consideration, where about all that is known is that the force passes through the piece, it is inadmissable to depend on this counteracting moment.

The method of the railroad company's engineer, given by Mr. Burrall, is also open to objection, the material being arranged in a very uneconomical manner. The plates being rigidly connected to the channel webs, the tensile force will be distributed uniformly over the entire area of the member, while the radius of gyration of the plates being smaller than that of the channels, the latter will, of course, carry proportionally more of the transverse load. In other words, the material near the neutral axis distributes its load to the flanges, while it is unable in return to relieve these of the stress due to bending moment. A practical example will make this plain. Suppose a member has to resist a direct tension of 100,000 lbs., and a moment of 360,000 inch-lbs. Two 10 in. channels, 80 lbs. per yard (I net 90) will resist the moment, while two plates, 10 in. × $\frac{9}{16}$ in., say 9.95 sq. in. net, will resist the direct tension. The net area of the combined member is 24.10 sq. in., and the net moment of inertia 261.

Then the maximum stress in the lower flange is

$$\frac{100.000}{24.10}+\frac{360.000\times 5}{261}=11,045 \text{ lbs. per sq. in.,}$$

or about 10 per cent. greater than the allowed strain. At the same time the upper flange is needlessly heavy.

The result obtained above, taken in connection with the fact that the strength of shape iron is 10 or 15 per cent. less than that of good bar iron, points to the use of longitudinal floor-beams, independent of the lower chords, when this form of floor is adopted. Yours truly,

JOS. A. BEAUMONT, C. E.

SPIRAL CURVES.

C., C. & I. C. RAILWAY,
OFFICE OF ENGINEER, MAINTENANCE OF WAY,
RICHMOND, Ind., March 22, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: It was with much surprise that I read the article in your last issue on "Spiral Curves," which must be very discouraging to the author of the method expounded in the preceding number, and I must take exceptions to most of the article.

If a road only employed a $2 engineer, with a $10 transit, I should say, leave all the engineering to a $1.50 trackman, with straight edge and bar. But is this the case? I can answer for some thousands of miles of the best road in the country—No!

For a second-class road with a few freight and local passenger trains that may be rattled over the road any way so that they get there, regardless of speed or comfort, most any kind of alignment may do, but for a trunk line, where from 50 to 100 heavy freight trains must pass over the same rails every day, and fast express and mail trains must be whirled around 6° curves at 50 miles an hour, too great care cannot be taken with the alignment. It is then that the spiral comes in as a blessing to the weary traveler in the sleeper by guiding the car gradually from a straight to a circular course, while the gradual elevation of the outer rail makes the increasing centrifugal force, scarcely felt instead of, as in case of circles alone, giving the car a shock that nearly turns the sleeping (?) traveler upside down at every P. C. and P. T.

I would ask, is not what is worth doing at all worth doing right? It is no more difficult to run in a curve with spiral ends than it is without them, the error not exceeding 0.10; and then the track may be put in condition to fulfill the conditions required of a track, while a butchered circle never can, as flattening the ends makes another part sharper than the original circle and requiring variations in elevation of the outer rail that the skillful trackman will never give it.

It is not claimed for spiral curves that they reduce the resistance of trains, but it is claimed that for a given speed the centrifugal and centripital forces can, throughout the entire length of the curve, be balanced, while with circles and straight lines it cannot be done.

I am sorry that more conservative engineers should think spiral curves of no practical value whatever, for "Young America" is putting them on the ends of all his curves in many places in this country with very gratifying results. It may be that they were attempted before their time had come, but with steel rail and stone ballast pains may be taken that on a road with old iron and a mud road-bed would have been wasted.

Yours truly, ENG M. OF W.

[If this easement at the P. T. can be retained in the road-repairing, you have our own experience as evidence that early conviction showed us the desirability of it, but if you have ever been engaged on road repairs, you do not need to be informed that its continuance is impracticable. "It is well to aim high, even though one fails of attainment." A very good sentiment for the school-boy's copy-book, but, in this practical age, will it not serve a better purpose, perhaps, to lower our aim a little, and, after finding absolute perfection unattainable, content ourselves with attaining the *best possible?* The young aspirant for engineering honors should do his whole duty as he understands it, leaving consequences to those who come after him. The uncertainty as to what the result may be should not discourage any refinement of instrumental labor which he has reason to believe as of practical value.]

RECENT INVENTIONS.

A late English invention consists of a rotary motive power engine, the cylinder of which is of annular form. Though its center passes a rotary shaft carrying a circular piston upon a radial arm. The steam is admitted through a valve chest on the outer upper periphery of the cylinder, the slide in which has three ports, the central one leading to the exhaust, and the outside ones passing down to a boss which secures the piston to the rotary shaft, and which is formed with two opposite chambers and ports, passing to the opposite sides of the piston, so that by shifting the valve the engine can be made to run in either direction. The cylinder is divided into two semi-circular chambers by radial slides which are alternately moved to allow the passage of the piston by means of eccentric cams on the rotary shaft.

A new safety attachment for elevators consists of a cable, one end of which is secured to, and combined with, the latching mechanism adapted to arrest the descending cage. The other end of the rope is attached to a weight. A grooved wheel is provided at the top of the elevator shaft, over which the cable travels upon the ascent or descent of the cage. A brake is arranged to arrest or retard the rotation of the grooved wheel, which is operated by the cage, should it, by accident, fall.

A late improved means for clearing the slots of wire-rope railways consists of a supplemental shaft or spindle, which is secured to a car or dummy, and provided with a toothed or cutting and breaking edge upon its inner end, adapted to rotate or move in the slot of a cable railway, with the driving axle of a car or dummy, to which it is geared, and operating in a reverse manner from that of the tread of the wheels of the dummy.

A new telephonic mouthpiece is composed of a diaphragm, the unsupported vibratory area of of which is composed of a flat annulus and a central hemispherical depression.

A novel car spring for railway cars comprises a graduated bolster spring, composed of a group of spirally coiled bars, placed side by side, and in which the spiral or spirals having the greatest bearing and carrying capacity is not acted upon by the load till after the other and weaker spirals of the group have been brought into action, and in which all the spirals under a given pressure shall become solid at the same time.

A new incandescent electric lamp provides the following method for attaining the much sought after perfect vacuum in the inclosing globe or bulb; that is to say, by forming the main bulb of the lamp with two small bulbs having free communication with said main bulb containing the incandescent filament of carbon; placing in one of said bulbs hydrate of potassa and in the other pumice-stone, saturated with sulphuric acid, exhausting and sealing the lamp in the usual manner, and then heating the carbon gradually from a low, red heat to incandescence, and finally sealing the main bulb of the lamp, and removing the small bulbs.

A new engineering structure consists of an elevated railway spanning a canal, with railway tracks supported thereon immediately over the canal. Pipes or conduits for conducting compressed air are arranged in groups on said structure, and other railway tracks supported upon said pipes or conduits.

A novel electric boring drill consists of an electro motor, a drill or stock rotated thereby, and mechanism for alternately advancing and retracting the tool. Electro-magnetic feed mechanism controls said movements. The device is provided more particularly with hydraulic feed mechanism interposed between the motor and tool, a water supply pipe, a compression chamber and valve, an electro-magnet controlling said valve, a gauge included within the electric circuit, and mechanism actuated by pressure in the compression chamber automatically to open or close said circuit, to operate said valve, and thereby regulate the water supply.

A novel telephone system, by means of appropriate switches, has the line battery which is located at the central office, so that it may be connected either through the transmitter or through the secondary of the induction coil to ground, and the transmitter can be put either into the local circuit or in the ground connection.

A new composition for sewer drain and water pipes consists of a concrete composed of coal tar, asphaltum, oxide of iron, sand or gravel, hydraulic cement or calcined plaster, and either with or without oils or salt.

A new system of electrical engineering in the drainage of excavations comprises an electro-magnetic motor, a force pump, a turbine wheel located at a proper distance below the pump, connected therewith by pipes, a dynamo-electric generator, and wires connecting the same with the motor, all being designed for mutual operation. The method by which this apparatus works is as follows: The conversion of the force of the water pumped up into an electric current when the same shall have fallen a distance greater than twice the vertical distance through which it was forced up, then reconverting the current into power and utilizing said power to work the pumps.

WASHINGTON, D. C. F. B. BROCK.

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.

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JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.

S. D. V. BURR ....ASSOCIATE EDITOR.

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Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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THAT our surmises, as indicated in the article on "The Outlook for Engineers" (issue of March 18), were correct has been shown by the decreased demand and consequent lowering of prices for rolling stock and steel and iron rails. Two weeks since orders could not be placed for delivery this year, even at the high rates then prevailing; while orders now can be placed for delivery in three months. The state of activity in the rolling mills and locomotive works presents an infallible test of the condition of the railroad enterprises throughout the country. One large locomotive establishment has already decided to slightly reduce its working force, and others are contemplating such a step. That the season will be unprecedented for the magnitude and wide-spread character of undertakings by municipal authorities and private individuals is clearly shown in the early commencement of work. Systems of sewerage and water-works are being built, and where now built are being greatly extended. and building operations are brisk in all sections. Money can be obtained at low rates, and, owing to the general confidence now prevailing, is freely put upon the market. Railroad enterprises seem to be the only ones which have run ahead of the demand.

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EAST RIVER BRIDGE.

IS AMPLE STRENGTH ASSURED?

Some anxiety and no little speculation has arisen as to the result to be anticipated from the discrepancy to be noted which appears from the measurements and calculations based upon them, of Gen. Newton, who, in pursuance of his official duties, has reported to headquarters at Washington the facts in feet and inches as he found them, descriptive of such parts of this bridge as were susceptible of measurement by him, and the possible changes to be anticipated in its progress to completion. In 1869 a commission was appointed by the Secretary of War to examine and report upon the proposed bridge. Their report, dated May 22, 1869, recommended the following conditions as properly controlling its construction:

"1. That the dimensions and coefficients of stability of the various parts of the structure shall not be reduced below those represented in the papers submitted to the commissioners.

"2. That the center of the main span shall, under no conditions of temperature or load, be less than the prescribed height in the clear above high water of spring tides as established by the U. S. Coast Survey. [The Chief of Engineers, Gen. A. A. Humphreys, to whom the report was made, recommended as the height to be prescribed 150 ft., subsequently fixed by Secretary of War Rawlins at 135 ft.]

"3. That no portion of the enrockments of the pier or tower foundations above the natural river-bed shall project beyond the pier lines as established by the laws of the State of New York.

"4. That no guys or stays shall ever be attached to the main span of the bridge which shall hang between the bottoms chords thereof."

It would appear from Gen. Newton's report that the height in the clear above mean tide under the circumstances of possible temperature and weight named would be but 134 42 ft., instead of the 135 required by law—but we are since informed that the suspenders are provided with a means of still further shortening them 1.25 ft., so that the cable may be adjusted to a height of 135.67 ft., or eight inches higher than need be, instead of seven inches lower. It is proper to remark that Gen. Newton was not in possession of this information at the time of making his report.

There remains to be reconciled the discrepancy between the coefficients of stability, *as represented in the papers submitted to the commission* in 1869, and what results from a computation of dimensions as at present determined upon.

What may have been the dimensions and estimate of weights, etc., submitted to the commission at that date, May, 1869, we have no means at hand for determining. We have newspaper reports from time to time, professing information upon some branch of this subject; but in a close comparison of dimensions, weight and factors of safety, such as this report to the War Department of the United States government calls for, we have no data sufficient to justify us in entering into an independant calculation. It would seem, however, that all the requirements of the United States government, so far as dimension and position are concerned, irrespective of inherent strength, have been complied with, and there remains only a question of—not how far the strength of the bridge is in excess of the weight of the maximum traffic which can by any possibility be brought upon it—and making all needful allowances for deterioration by time and the elements, this excess of strength is ample for the service to which it may be subjected, and so a safe structure for the government to accept; but the question will be, perhaps, does this excess of strength equal the ideal standard assumed as a requisite margin of safety, when the bridge was projected, and which was embraced in the law under which its construction was legalized?

The factor of safety of 5, of which so much use is made, is an entirely arbitrary one, resting upon no theoretical basis, but purely a matter of judgment and a precautionary measure, rendered necessary in view of the increase in the weight and speed of rolling stock, and the uncertainty attending the varied manipulations of a material so universally in demand as iron and steel, under the new conditions of strength and lightness imposed by the more modern structural requirements.

This factor of safety has been largely increased under the circumstances named, wherever such material is called into use to resist permanent tensional strains, etc., and it is customary after estimating these strains to provide a margin of strength of from 5 to 6 times, where formerly it was customary to use from 3 to 4. About 60,000 lbs. to the square inch tensional strain, having been regarded as the average breaking weight of good wrought iron, the tension which would produce a permanent alteration in its length was found to be about 17,800 lbs.; hence the ratio of 17,800 to 60,000, or as 1 : 3.37 was taken to express the proper ratio between the tensional strains caused by load, and the elements of resistance. In the many suspension bridges built on the Continent of Europe years since, and still in existence, this ratio was invariably taken, but we shall refer to but one of them.

The first *wire* suspension bridge of any considerable dimensions ever erected was built at Freiburg, the capital of the Swiss Canton of the same name, in the year 1834. This bridge spans the Sarine River at a height of 170 ft. The length between points of suspension is 870 ft., and until the constructions of Mr. Roebling in this country, was the largest single span suspension in existence.

The $5\frac{1}{2}$-in. cables, of which there were *four*, consisted each of 1,056 wires of No. 18 (French), laid straight as in the Brooklyn bridge, but unlike them, were not laid up in place, but built upon a platform and raised into position, having a versine of 63 ft., nor were they wrapped continuously from end to end, but only at intervals of several feet, so that for over half of the length of the cable the wires are exposed to view. The bridge is without stays or stiffening trusses, beyond that afforded by a wooden trussed hand rail $3\frac{1}{4}$ ft. in height on each side.

The platform is 24 ft. in width for highway travel, of timber, having double cross beams at intervals of 4 ft. 11 in., covered with two courses of planking. The weight suspended, including cables and suspenders, the latter also of 1-in. wire, is estimated at about 400 tons. Among the tests to which it was put before opening for travel was driving 15 pieces of artillery, with 50 horses and 300 men on the platform, and concentrating them at different points; when concentrated as near the center as possible, the deflection of the cables was increased $39\frac{1}{2}$ inches. A procession of 2 000, with a military band, marched in step repeatedly across the bridge. The published statement of the trial load, as it was called, was as follows: The breaking strain of the wire was 102,427 lbs. per square inch, and it was tested with a total load of 38,410 lbs. to the square inch of cable: or, the coefficient of strength of the cables was .375 of their ultimate strength, and the factor of safety was $\frac{102\,427}{38{,}410} = 2.68$. The bridge was built in 1834, and is still in constant use, as most tourists can testify, but probably never has been loaded to within one-fourth of its strength in practice. This illustration is given, not to discredit the custom of adopting the factor of safety of 5 or even 6 for structures in iron and steel, but to show the ideal nature of this factor when applied in disregard of the circumstances of the case. For short iron truss bridges, under the action of modern locomotives, the live load per lineal foot sometimes equals the dead load, and for long spans even, the live load per lineal foot is not safely taken at less than one-half of the weight of structure. It is manifestly proper in such cases, therefore, to provide a margin of strength indicated by a factor of 6; but where the weight of the structure is a large multiple of the possible or live load a smaller factor or margin is proper.

Taking the figures of the engineers, the weight of the river span borne by the cables, including their own weight, is 5,037 tons. The maximum live load, occasioned by loading the bridge from end to end, would give on this span 1,311 tons, and allowing about one-third of this to be borne by the stays, would leave 1,000 tons to be borne by the cables, or the live load is to the dead load borne by the cables as 1 to 5. Accepting the factor of safety as determined by all the computors to be 4.14, let us see what this means in the present case, and for simplicity of calculation call the factor of safety 4 instead of 4.14, and confine our consideration to the cables and the dead and live load borne by them alone. As we understand this expression it means that if this span of the bridge were under its maximum live load of 1,000 tons it would require four times this load in *addition to the weight of four such bridges*, to equal the breaking weight of the cables. To make this clearer: The weight of this span borne by cables is, in round numbers, 5,000 tons, the live load on the cables is 1,000 tons with a factor of 4, the strength of the cables is 5,000 + 1,000 = 6,000 × 4 = 24,000 tons; of this, subtracting the weight of the river span itself, or 5,000 tons, leaves 19,000 tons, or *nineteen times* the greatest possible live load which can be put upon the bridge, would, with the weight of the bridge itself, represent its breaking weight. This is what the factor of safety in this bridge represents, and not that the bridge will bear but four times the maximum live load, as the statement of the President of the Board of Trustees might lead one to suppose. Such portions of the structure as may be exposed to shocks or vibrations have the full factor of 5 or 6, but the cables will never be exposed to such variations of strain, and taken in connection with the inertia of the mass of the superstructure, exhibit an ample margin of strength for all the service which it may be called upon to meet.

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LAKE GEORGE WATER SUPPLY.

We took occasion in No. 10 of ENGINEERING NEWS to notice the fact of the introduction in the Senate of the State of New York of the bill to incorporate the New York & Hudson Valley Aqueduct Company for the purpose of supplying the cities and towns on the Hudson River, including the city of New York, with pure water from Lake George, and stated the general features of the project so far as then known. The report of the Chief Engineer, J. T. Fanning, of the results of his examinations, is now before us, and we make such extracts from it as will put our readers in possession of the facts upon which the petitioners rely for securing a charter of incorporation from the Legislature.

Lake George, in Warren County, is some 34 miles in length, and of an average width of $1\frac{1}{4}$ miles, and has a water-shed of some 300 square miles. The level of the lake is 322 ft. above mean tide, and distant by the line of survey 225 miles from the Harlem River. The water-shed of the lake, it will appear, is a little less in extent than that of the Croton River, which, at present, supplies New York City. Of course, there would be no object in bringing its waters to the city, were there no means of increasing the supply beyond that afforded by the shed of the lake alone; but the upper Hudson, above Glen's Falls, drains some 3,000 square miles, and by a dam across the Hudson

River above that point, is made tributary to the lake, rendering the latter in a measure a storage reservoir. The analysis of the waters, both of the lake and the upper Hudson River, are shown favorably in comparison with other waters of city supply. Taking the available statistics of rainfall near that region, the engineer estimates the mean annual rainfall as probably not less than 40 in., and deducting 50 per cent. for various sources of loss, concludes that in the dryest year 7.8 in. would be available for riparian rights and 12.2 in. for storage, and that 1,500,000,000 gallons would represent the daily average which might be calculated upon for city supply. Reviewing the past experience of the city of New York in its consumption of water and its needs for the future, the engineer projects the proposed work for the present at 500,000.000 gallons daily brought into the city. This is secured by an open canal of 60 ft. in width and 13 ft. deep, with a fall of 6 in. per mile; the banks of the canal revetted with stone, and in localities requiring that precaution, paved and even covered with a roofing. The crossing of depressed valleys being effected by means of wrought-iron pipes of 7 ft. diameter. Raising the banks 16 in. is computed as adding to the flow of the canal 100,000,000 gallons daily. As to the value of the supply for power or otherwise on the line of the canal following the east side of the river valley the heights at various points are stated as follows: Elevation of Lake George, 322 ft.; elevation opposite Troy, 286 ft.; elevation opposite Albany, 283 ft.; elevation opposite Hudson, 268 ft.; elevation opposite Poughkeepsie, 248 ft.; elevation opposite Fishkill, 241 ft.; elevation opposite Peekskill, 229 ft.; elevation opposite Sing Sing, 222 ft.; elevation opposite Yonkers, 213 ft.; elevation at Harlem River, 200 ft.

From the terminus of the canal near High Bridge the water will be conveyed into the city by iron pipes, which may be extended to Jersey City, or, indeed, by the same method any towns or cities along the valley of the Hudson may be supplied; the approximate estimate of the cost being for 210 miles of canal $26.250,000; seven miles of tunnel, $4.900,000; ten miles of syphon, $10,000,000; and the Hudson dam and canal, land and water rights, etc., engineering and contingencies, $8,125,000, or a total of $49,675,000. The favorable circumstances in connection with the location of the line, and the facilities for transportation of labor and material, both by water and railroad, it is expected, will limit the time required for the completion of the work to that necessary for the most difficult portion of it, say the tunnels—or about three and a half years. From the census statistics of the State for 1875, it appears that nearly 40 per cent. of the population of the State in the thirty towns on the river, may be more or less benefited directly by the construction of this canal.

The report of the engineer is systematically arranged and discussed with ability under the following heads, and referring to diagrams of sections of canal and general map of the country: Altitudes of the Lake Waters. Availability of the Water-shed. Available Volumes of Water. Quality of the Water. Quantity of Water Required in the City. Method of Construction. Estimate of Cost. Time Required for Construction. Extended Usefulness of the Water. Statistical Tables. Unless by copious extracts, too extended for the present article, it would be difficult to do justice to the report, which goes less into the engineering problems to be solved and the methods in detail for their solution, than to the general principles involved, which, in the opinion of the petitioners, justified their application at this time for legislative authority for the construction of the work. A brief recapitulation of the bearing of the proposed work on the future of this city and the valley of the Hudson is shown, however, and we quote from it as follows:

> "In recapitulation it will be observed that we have shown that the waters of Lake George and the Upper Hudson may, by the use of a short tunnel, be made available—that they may be conducted by an even flow throughout the year by a canal to New York City, and by pipes to the remaining cities of the harbor and the Hudson Valley—that they have sufficient altitude to reach New York City with approximately 200 ft. head above tide-water—that Lake George, as it is intended to develop it, will equalize the flow of 1,500,000,000 gallons of water daily, a supply for 10,000,000 people, without injury to existing water rights—that the water is of exceptional purity, and the conditions are favorable for the maintenance of the purity of the water—that 500,000,000 gallons of water can be brought down to the cities within about three years, and that the capacity of the canal may be readily and cheaply increased as the requirements of the city increase.
>
> "As respects the city of New York, it has been shown that an abundant supply of water and increased pressure will encourage new manufacturing and commercial enterprises in the city, improve the sanitary conditions, more efficiently protect life and property from fire, relieve the citizens of the annoyance and expense of pumping their individual supplies to disease breeding tanks for domestic use, give them hydraulic passenger elevators in their commercial and domestic buildings, give them pure and sweet water to drink all the year round, supply their park lakes and fountains, and public drinking fountains, and thus in many ways tend to enhance the comfort, safety and health of the citizens in household, office, shop and public park, and develop the wealth-producing resources of the city. Beyond this it will give the cities along the Hudson that desire to avail themselves, all the advantages of a pure and abundant water supply that any city of America enjoys, it will give aid and impetus to the development and occupation of the manufacturing sites along the shores of 150 miles of navigable channel of the Hudson River, it will indirectly augment the ratable value of the State, and it will become a powerful incentive to a rapid development of the commonwealth into a magnificent future.
>
> "While New York City is incumbered, as at present, with a bonded debt exceeding one hundred and thirty-five million dollars and net debt of ten per cent. of its total valuation of real and personal property, it is probable that a majority of her citizens will conclude, as you have done, that it is not now expedient for her to undertake so great an enterprise as is herein proposed for the benefit of herself and her sister cities, or even so much of an undertaking as now seems necessary for her own preservation; but the work is a legitimate object for private enterprise, and results have sometimes proved, in similar examples of less magnitude, that private enterprise succeeds in negotiating for necessary water rights and land and executing necessary works with more marked economy than public officials.
>
> "The income in the year 1880 from water rents from pipes already laid in the several cities named that may avail themselves of a supply of water from the proposed works exceeded three million dollars, and the annual income may reasonably be expected to be considerably enhanced by the increased demand for a superior and ample supply of water with increased pressure, so that if you shall be able to make reasonable contracts for furnishing this water you may expect a fair remuneration for your outlay at the outset, and a continually augmenting income as the demand for water increases with the growth and development of the several municipalities."

THE IRON TRADE.

The output of iron and steel is apparently steadily increasing, as is evidenced by the increase of furnaces in blast and the increased production of those already in blast. The announcement of new rolling mills projected or under construction is frequent. A half-dozen are now under way in Pennsylvania, and, perhaps, as many more are projected. A falling off in railroad enterprise, or poor crops, either or both, will dampen enterprise in iron making. Railroad stocks and bonds are at present in excess of demand, and hence an unfavorable impression has gone abroad, which, in some directions, has brought about a restriction of operations. It is as well that a check should be placed upon railway enterprise by prudence. The legitimate necessities of the country are expanding very rapidly, and to provide for them will call into use all our present productive capacity.

There has been very little failure among buyers of railway material to take and pay for material ordered. In fact, there has been very little retracing of steps taken in construction. West of the Mississippi there was some undue activity, arising out of efforts of one set of capitalists to anticipate another set. The consolidation of these interests into the Gould system has led to a relinquishment of the construction of some contemplated mileage. Apart from this, enterprise has not been seriously checked. The difficulty, and, in fact, impossibility of obtaining rails, and other material, including rolling stock and motive power, has retarded construction here and there. Besides this, contemplated repairs have been postponed in some cases. The investing public, who have the utmost confidence in our railway system, and who have, perhaps, too little fear of too much mileage, demand a system of railway management which will make investments more secure, and which will, if possible, give stockholders more control of their property than they now seem to possess. Manufacturers of rails, locomotives and rolling stock have had very few intimations of declining activity in railway construction, although there are undoubtedly causes at work, which, if unopposed or nullified, will in time produce evidences of the fact in diminishing orders. The rush of emigrants continues. The movement of population from the Eastern States to the Western has been lessened by the increasing industrial activity; yet, there is an increasing necessity for new roads west.

The Bessemer mills now control the American demand. Contracts have been recently entered into for steel rails under $55 per ton, and requirements of great magnitude are now under consideration for winter and spring delivery. The ordering of rails abroad has practically ceased, except for one or two localities, where foreign freights are lower than freights from American mills. At present home rails can be furnished at mill $5 per ton cheaper than foreign rails can be delivered at tide. Competition may lessen this figure, but increasing capacity here may still further reduce home quotations.

The various other branches of the iron market are in a healthy condition. Mills are generally crowded with orders, though for shorter times than a few months ago. Supply has virtually overtaken demand, and hence consumers do not feel it necessary to order more iron than they require. The spring demand is backward, not because of declining consumption, but because of fears that between increasing output at home and the possibility of imports, consumers expect to buy cheaper by delay. An ultimate decline in iron and steel is inevitable, but an urgent demand is keeping the tendency in check.

Tariff legislation is progressing slowly. The proposed reference of the entire matter to a commission will prevent ambitious persons from gratifying selfish persons to make political capital, but it will meet the views of the great body of the people, who desire to see impartial legislation enacted.

PERSONAL.

MR. O. E. FARNSWORTH, formerly of the Missouri Bridge Company and a large contractor for bridges on the Omaha extension of the Missouri Pacific, died recently at Doniphan, Kansas.

W. W. COE has been appointed chief engineer of the Norfolk & Western Railroad; headquarters at Roanoke, Va. On the same road George Hoffman has been appointed engineer maintenance of way, with headquarters at Lynchburg.

MR. JAS. H. HANDYSIDE, formerly of the contracting firm of engineers of W. R. & I. Handyside, later managing director of the Ogereff Works, Russia, and for the last thirteen years managing director at the works of Thomson, Sterne & Co., Glasgow, died in that city recently at the age of forty-six years.

GENERAL MANAGER ODELL and Chief Engineer Graham, of the Chicago, Texas & Mexican Central Railroad have tendered their resignations for reasons not made public. Rumor has it, however, that legal proceedings are to be begun against the company in the interest of creditors who desire the appointment of a receiver.

MR THOMAS AVELING, the senior partner of the firm of Aveling & Porter, the well-known manufacturers of steam road rollers, died March 7 at the age of 58 years. Mr. Aveling was a member of the Institution of Civil Engineers, and also of the Institution of Mechanical Engineers, and of the Iron and Steel Institute.

UNITED STATES AWARDS AT THE VENICE EXHIBITION.

Gen. Wright, Chief of Engineers, has received a report from Captain George M. Wheeler, delegate of the United States to the Geographical Exhibition and Congress at Venice, showing that the following awards were made to the United States:

Class 1 (Mathematical Geography, Geodesy and Topography).—First, Corps of Military Engineers, for the completeness of its works.—Letter of distinction. Second, Geographical survey of the War Department, for completeness of works.—Letter of distinction.

Class 2 (Hydrography).—Third, Treasury Department, Coast and Geodic Survey, for its work relative to the Gulf of Mexico.—Letter of distinction. Fourth, Navy Department, for the completeness of its works.—Letter of distinction. Fifth, Treasury Department Lighthouse Board for publications and charts of lighthouses.—Diploma of honor of the first class.

Class 3 (Physical Geography, Meteorology, Geology, Zoology and Botany).—Sixth, War Department, for completeness of works. Given more especially on account of publications of geological explorations of the 40th parallel.—Letter of distinction. Seventh, War Department, United States Geographical Survey, for the completeness of its works.—Letter of distinction. Eighth, War Department, Meteorological Bureau and Signal Service, for tri-daily weather charts from November 1, 1871, to December 31, 1879.—Letter of distinction.

Class 7 (Commercial and Statistical Geography).—Ninth, Post-Office Department, for publications relative to the service of the post-office, postal charts, laws and regulations, guide reports, &c.—Letter of distinction. Tenth, Commissioner of Agriculture, for annual reports.—Diploma of honor of the second class. Eleventh, Bureau of Statistics, for the completion of its works.—Honorable mention.

Class 8 (Explorations and Surveys).—Twelfth, War Department, for its various explorations.—Letter of distinction.

Letters of distinction were the highest awards conferred, diplomas of honor and honorable mention following successively.

THE TEMPERATURE OF TUNNELS.

Observations in shafts, mines and borings show that at a certain depth (about 29 meters) below the surface the temperature is the same all the year round. The exact law as to increase of temperature beyond that depth is not known; it is assumed, however, that it rises from 0.03 to 0.033

degree C. for each additional meter of depth, consequently by 1 degree for every 30 to 33 meters of depth. Special circumstances, such as the influx of warm water, decomposition of gravel and feldspar, slow combustion of coal, etc., may, naturally, involve changes in certain places. Thus, in the celebrated Comstock mines, Nevada, a temperature of 40 to 50 degrees C. prevails at a depth of 600 to 800 meters. But the depth reached by mines is by no means so great as the height of the mountains superincumbent upon the tunnels which are passing under the Alps, or are to be made through them. Fortunately, the above increase of temperature does not take place in tunnels, but stands in relation to observations in plains or on mountains of medium height. The Mont Cenis Tunnel, for instance, at its center is about 1,350 meters above sea-level; the highest part of the moutain chain below which it runs is 1,600 meters higher. The prevailing tempereture there is for the air, 6 degrees C.; for the mountains, 1 degree C.; the temperature observed in the tunnel shortly after its completion was 29½ degrees C., making a difference from the summit to the tunnel center of 30½ degrees C. Thus, the increase of temperature would be 1 degree C. to about 52 meters depth under the mountain chain. We possess very exact scientific observations on the temperature of the St. Gotthard tunnel. The influence of the outer temperature is felt for only 2 to 3 kilometers in the tunnel; thence the temperature depends upon the mass of the overlying rock. In the center of the tunnel, 1,154 meters above sea-level, the temperature is 30½ degrees C.; on the summit, 1,700 meters higher — 1 degree C. M. Dubois-Reymond, who assisted in making observations in the St. Gotthard tunnel, came to the conclusion that work may be carried on just as easily in a dry atmosphere of 50 degrees C. as in a moist atmosphere of 40 degrees C.; those two figures forming the limits within which man is able to work for any length of time.

ENGINEERS' SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.

RECORD OF REGULAR MEETING.

March 18, 1882.

President Rudolph Hering in the chair. Twenty-two members and three visitors present.

President Rudolph Hering presented notes on the Resistance to Traction on Streets, giving results compiled from various authors who had experimented on the subject. Resistance varies nearly as the weight, being great for heavy loads and almost nothing for light pleasure carriages. It increases on paved streets with the velocity and as the diameter of the wheels becomes less. The width of tire has little influence on hard and smooth roads, especially for light loads, while it has considerable influence on soft end rough roads, particularly when the load is heavy. The most economical conditions for traction, therefore, are a herd end smooth surface, large wheels and broad tires; the latter for heavy loads drawn on rough roads. To draw a load on sand requires a power equal to $\frac{1}{5}$ its weight, on ordinary earth $\frac{1}{11}$, on hard clay $\frac{1}{18}$, on ordinary cobble-stones $\frac{1}{16}$, on good cobble pavements $\frac{1}{25}$, on ordinary Belgian blocks $\frac{1}{38}$, on London blocks $\frac{1}{55}$, on asphalt $\frac{1}{112}$, and on iron rails $\frac{1}{168}$ of the load.

The economy in horse-power obtained by using the hardest and smoothest roads is clearly shown. If one horse can just draw a load, on a level, over iron rails, it will take 1⅔ horses to draw it over asphelt, 3⅓ over the best Belgian, 5 over ordinary Belgian, 7 over a good cobble-stone, 13 over a bad cobble-stone, 20 over an ordinary earth road and 40 over a sandy road.

Mr. D. H. Shedaker exhibited a large and very complete work on "The Art of Surveying," by John Wing, published in 1699, and presented report of Mr. Heber S. Thompson, Engineer Girard Estate, upon the extinguishment of the fire at Kehley's Run Colliery.

Mr. W. S. Auchincloss exhibited his averaging machine, which consists of a stand with two uprights which support a rectangular pan 29 in. long and about 10 in. wide. The edges of this pan are formed of tubes, which slide through the bearings and inclose rods forming counterweights. These rods are connected by pulleys with the pan so that, when it is moved in one direction, they move in the other and so preserve the equilibrium.

The pan is divided into equal grooves at right angles to its length.

Paper scales, graduated for various uses, accompany the machine, and the adjustment is so accurate that the absence of a scale, which forms part of the balanced weight of the pan, throws the machine entirely out of balance. A convenient series of weights is provided to compose the quantities to be averaged. We place these in grooves opposite their appropriate points on the scale, slide the pan until in equilibrium and read the average at once from the scale, at the point of support.

This machine was designed especially to average commercial accounts, and can solve 100 accounts per hour and work both sides of ledger at once; but it is also adapted to ascertain average haul of earth, speed of pulleys, etc.

The Secretary presented a description of Defenbach's rail joint.

HOWARD MURPHY,
Secretery and Treasurer.

MICHIGAN ASSOCIATION OF SURVEYORS AND CIVIL ENGINEERS.

The third annual meeting of the above association was held at Lansing, Mich., on the 10th, 11th and 12th of January last, and the Proceedings, in a printed pamphlet of fifty-six octavo pages, are just received. There are 114 members. The officers for 1882 are: Prof. Chas. E. Greene, of Michigan University, President; nine vice-presidents representing each of the State Congressional Districte; Prof. R. C. Carpenter, of the State Agricultural College at Lansing, is Secretary and Treasurer; and there are also an Executive Committee, a Special Committee on Manual, and a Special Committee on Legislation.

The Proceedings grows in value with each number, and already those published form a most valuable compendium of information for practical land surveyors, while there are several papers of value to civil engineers. The papers published in the present Proceedings include A Bill to Establish a Board of Commissioners of Surveys (heretofore published in ENGINEERING NEWS); Foundetions and Piers of the Wheeling & Lake Erie R. R. Bridge across the Maumee River at Toledo, Ohio, by Prof. Charles E. Greene; Water-Works for Small Cities, by G. W. Pearsons, C. E., of Kansas City; Construction of the Michigan Reform School for Girls at Adrian, by Burton Kent, Superintendent of Construction; Compass Deviations on Vessels and the Conversion of Compass Courses, by H. C. Pearsons, U. S. Inspector of Steam Vessels; Drainage Engineering, by Prof. R. C. Carpenter; Practical Questions in Land Surveying; Subdivision of Sections; Horizontal and Vertical Distances without the Use of a Vertical Arc or Stadia Wires, by H. C. Pearsons, and a Table of Variations of the Needle. The papers are written by men well versed in both theory and practice, but are prepared with a view of being so easily comprehended as to be of daily use to the average surveyor or engineer.

The secretary, in opening his report, makes the cheerful remark that "the present winter has been one of the most favorable for active surveying and engineering work ever experienced in the State;" and of the society he remarks that "this association is the only bond of union between individual surveyors and engineers of our State; it affords to them a means of mutual acquaintance, of education, and finally constitutes an organized body which can be made to exert a great influence in securing desired legislation. The aim is to compactly unite all civil engineers and surveyors, whatever special branch they may follow; and to secure thet end, matters of interest to each particular profession will receive attention at the regular meeting." The pamphlet is for sale at twenty-five cents, and can be had of the secretary, Prof. Carpenter, at Lansing, Mich.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 100.

CCLI.—SCRANTON.

Scranton, Pennsylvania, in lat. 41° 23′ N., long. 75° 39′ W., is on both sides of a wide valley through which flow the Lackawanna River and Roaring and Stafford Meadow brooks.

Settled in 1788, it was incorporated as a borough in 1856 and as a city in 1866.

Water-works were built for a private company in 1857 by Joseph Battin, taking the supply from the river by pumping. In 1866, the sulphuric acid in the mine waters draining into the brook polluted the supply to such an extent that the source was changed to a reservoir on Roaring Brook, 4½ miles from the city and 400 ft. above the Lackawanna River, or 300 ft. above the general level of the city.

In 1871 the works were enlarged and rebuilt after the plans and under the superintendence of C. E. Judson, C. E.

Water is taken from a mountain lake of 196 acres area, with one square mile of water shed, 19 miles from the city. It contains 300,000,000 gallons. The water flows from it through the channel of Roaring Brook, on which a storage reservoir is formed 4½ miles from the city, by a dam of stone masonry 320 ft. long and 35 ft. high, 8 ft. wide at top and 22 ft. at bottom, except for 100 ft., which is 35 ft. wide. The upstream face is vertical and the lower face batters 1 in 3. The spillway, 100 ft. long, is stepped on the face with cut stone.

The water shed above this dam is 18 miles long and 2½ miles wide. The reservoir holds 80,000,000 gallons. The water is passed through a sand and gravel filter into two lines of 16-in. cast-iron pipe, which convey it to the distribution. Pressure is equalized by a reservoir of 1,000,000 gallons capacity, 200 ft. above the distribution level, and a wrought-iron stand-pipe 4 ft. in diameter, with an overflow. The ordinary pressure maintained in the mains is 50 lbs. per square inch, which can be increased to 125 lbs. by making direct connection with the high reservoir.

Distribution was at first by wrought-iron and cement pipe. Cast-iron pipe is now used, and has been largely substituted for the other in the old mains. There are now 29½ miles of pipe in use, with 106 fire hydrants, 211 gates and 1,047 teps. The city pays $3,000 per year for public supply.

Service pipes are of lead and of galvanized iron.

The population in 1880 was 45,850, and the daily consumption 5,000,000 gallons.

The Gas and Water Company has a capital of $456,000. The works for supplying both gas and water have cost $680,000. No further financial statements are furnished.

The positions of superintendents and engineer have been filled by John Merrifield, Charles Fuller, Henry Battin and the present incumbent, C. E. Judson.

CCLII.—YREKA.

Yreka, California, in lat. 42° N., long. 120° W., is in the heart of the Rocky Mountains. Settled in 1851 it was incorporated as a village in 1855. Water-works were built in 1861 by private enterprise, collecting the water of a number of springs by a wooden trough 8 in. square, with a fall of 1 in 200, and leading it to a wooden tank holding 60,000 gallons, and situated from 22 to 50 ft. above the town. The water is conveyed from the cistern half a mile through bored pine logs of 6-in. diameter and distributed through 4-in. cast-iron pipe. There are 12 fire cisterns and 96 taps. The town does not pay for use of water.

The population in 1880 was 1,500, end the daily consumption 60,000 gallons.

The works cost $10,000. No further financial statistics are given.

Henry Scheld is the Manager.

CCLIII.—CHELSEA.

Chelsea, Massachusetts, in lat. 42° 24′ N., long. 71° 1′ W., is on the Mystic River, opposite to Boston. It was settled in 1738, and incorporated as a city in 1857. Water-works were built by the city in 1867, after the plans of T. E. Ames, and under superintendence of William A. Williams. Water was taken from Mystic Lake, under a contract with the city of Charlestown, which at that time controlled the lake. The works at the lake, now owned by the city of Boston, were described in ENGINEERING NEWS of April 2, 1881. The distribution in Chelsea is by 28½ miles of pipe, of from 16-in. to 3-in. diameter. The first pipe laid were of wrought iron and cement. The extensions since 1875 heve been of cast iron. There are in use 136 fire hydrants, 228 gates, 4,171 taps and 47 meters. The city pays for use of fire hydrants, $28 for each 350 inhabitants. Lead service pipes are used. The population in 1880 was 21,782, and the daily consumption was about 1,000,000 gallons.

The works have cost $354,211, or exclusive of interest on the debt of $200,000 at 6 per cent.

The cost of maintenance in 1880 was $4,938.05, and the interest on bonds and on pipe across the Charles River was $14,330.42. The receipts were $12,210.68.

The works are managed by a board of three commissioners. Caleb Lombard is the general agent.

CCLIV.—PETALUMA.

Petaluma, California, in lat. 38° 18′ N., long. 122° 37′ W., is on Petaluma Creek, at the head of navigation, 10 miles from San Pablo Bay, in a valley surrounded by hills. Settled in 1852, it was incorporated in 1857. Water-works were built in 1872 for a private company by M. J. Miller, after the plans of Thomas Bros. The supply is taken from mountain streams, draining 20 square miles. A 7-in. riveted wrought-iron pipe conveys the water to a reservoir 150 ft. square, in excavation and lined with brick, holding 2,000,000 gallons at 175 ft. above the town.

Distribution is by cast-iron and some riveted wrought-iron pipe. Twenty-five miles are laid, with 18 fire hydrants, 8 gates and 650 taps. The town does not pay for hydrants. The population is 4,000. The consumption is not known.

The capital stock of the company is $150,000. The works have cost $130,000, and the receipts so far have amounted to $94,000. There is no debt.

The expenses in 1880 were $4,800, and the receipts $12,700. F. W. Lougee is the Secretary and Superintendent.

CCLV.—TORRINGTON.

Torrington, Connecticut, in lat. 41° 50′ N., long. 73° 12′ W., is on a small stream, in a broken and rocky country. It was settled about 1800.

Water-works were built by a private company in 1878, after the plans of William B. Rider, taking the supply from the stream, which drains about 8 squire miles.

An earth dam, 234 ft. long and 20 ft. high, with rubble masonry heart wall, 8 ft. wide at bottom and 3 ft. at top, forms an impounding reservoir of 5¼ acres area, and holding 18,000,000 gallons at 175 ft. above the town.

The water is filtered before entering the distribution pipes, by being passed through charcoal and then through sponge, with satisfactory results.

Distribution is by cast-iron pipe, of which 5¼ miles are laid, with 25 fire hydrants, 37 gates and 250 taps. The population in 1880 was 2,998. The consumption is not given.

The capital stock of the company is $40,000. The works have cost $32,000, and there is no debt.

The expenses in 1880 were $500, and the receipts $3,100. C. L. McNeil is the Secretary and Treasurer, and O. R. Fyler the Superintendent.

CCLVI.—OTTUMWA.

Ottumwa, Iowa, in lat. 41° 2' N., long. 92° 23' W., is on the Des Moines River, which at this point has a fall of 10 ft. in half a mile, affording a water-power which has been utilized by the construction of a dam and race, built by Edward Ruger, C. E.

The town was settled in 1844, incorporated as a village in 1851, as a city in 1857, and reorganized in 1868.

Water-works were built in 1878 by a private company, which made a contract with the city to complete the water-power and furnish water for domestic and fire purposes. The works were designed by S. L. Wiley, and built under the superintendence of E. C. Cooke, C. E.

Water is conducted from the river through a canal 4,000 ft. long and 40 ft. wide, to a settling basin 220 by 180 ft. From this it passes through a filter of brick 20 by 22 ft., containing several screens filled with animal charcoal. This is stated to be capable of filtering 3,000,000 gallons per day.

From the filter the water passes through 400 ft. of 20-in. wrought-iron pipe to the pump-well, whence it is lifted 204 ft. by two Flanders water-power pumps and one Knowles steam pump, to a reservoir holding 2,500,000 gallons, and 204 ft. above the city.

Distribution is by 10 miles of cast-iron pipe of from 16 to 4-in. diameter, with 76 fire hydrants, 37 gates and 390 taps. Six meters are used. The city pays $82.50 per year for each hydrant. The population in 1880 was 9,018, and the daily consumption 1,000,000 gallons. Financial statistics are not given.

W. F. McCue is the Superintendent.

CCLVII.—LAFAYETTE.

Lafayette, Indiana, in lat. 40° 26' N., long. 86° 53' W., is on the Wabash River, on rolling ground.

It was incorporated in 1825.

Water-works were built in 1876, by the city, after the plans of Henry Earnshaw, C. E., taking the supply from the Wabash River and pumping it by two Clapp and Jones steam engines, with 25-in. steam and 10-in. water cylinders of 34-in. stroke, into a reservoir 225 ft. above low water in the river, 60 by 120 ft., built of earth embankment above the natural surface. The inner slopes are puddled with clay, on which is laid a pavement of cobble stones, grouted with cement. The bottom is covered with 1 ft. of concrete.

The 16-in. force main, 10,000 ft. long, is connected with the distribution mains and terminates in a stand-pipe of 24-in. diameter and 72 ft. high, in the centre of the reservoir. Water is pumped at will into the reservoir, into the distribution direct, or into the stand-pipe, which is used to furnish fire pressure to the higher part of the city.

Distribution is by 16 miles of cast-iron pipe, with 150 fire hydrants, 102 gates and 802 taps.

The population in 1880 was 14,860. The consumption is not given.

The works cost, to 1878, $266,682.97.

The bonded debt is $300,000 at 8 per cent. interest.

The expenses in 1880 were $11,179.85 and the receipts $11,506.33.

The works are managed by three Trustees.

R. B. Wallace is the Superintendent.

CCLVIII.—MISSION SAN JOSÉ.

Mission San José, California, in lat. 37° 30' N., long. 121° 50' W., was settled by the Jesuits about 1775. Water-works were built by J. Keene and J. W. Coleman about 1870, taking the supply from two springs, the water from which is conveyed 4,000 ft. in a brick drain 2 by 4 in. in the clear, to a concrete tank 30 ft. in diameter and 10 ft. deep, on ground 40 ft. above the highest part of the town. Distribution is by 3,000 ft. of 3-in., 2-in. and 1½-in. wrought-iron pipe, with 82 taps. There are no fire hydrants. The daily consumption is about 20,000 gallons.

The cost of the works is not given. The cost of maintenance in 1880 was $40, and the receipts $600. P. L. Merritt is Superintendent and agent for the proprietors of the works.

CCLIX.—COVINGTON, KY.

Covington, Kentucky, in lat. 39° 5' N., long. 84° 28' W., is on the south bank of the Ohio, at the mouth of the Licking River, on nearly level ground.

It was incorporated as a village in 1815 and as a city in 1834.

Water-works were built by the city in 1870, after the plans of Birdsall Holly and under the superintendence of William C. Weir, C. E.

A wrought-iron tube 18 ft. in diameter and 71 ft. high was sunk through the gravel on the river bank. In the bottom of this well 35 3-in. perforated pipes were driven 12 ft.

Sixteen feet above the bottom of the well, a plate-iron floor was placed, on which rested two piston engines and one rotary engine, of the Holly pattern, driving a "gang" of 12 piston pumps and 2 rotary pumps.

The well failed to furnish sufficient water some years ago and the supply is now taken direct from the river by a 20-in. pipe. The rotary engine and pumps have been removed and piston pumps substituted and a McGowan pumping engine added.

The water is pumped directly into the mains, with an ordinary pressure of 60 lbs. and fire pressure of 100 lbs. per square inch. Distribution is by 24 miles of cast-iron pipe of from 20 to 4-in. diameter, with 215 fire hydrants, 35 fire cisterns, 75 gates and 1,998 taps. Three meters are in use.

The population in 1880 was 29,720 and the daily consumption 500,000 gallons.

The works have cost $500,000. The expenses in 1880 were $25,000 and the receipts $30,000. W. H. Glore is the Superintendent.

CCLX.—WESTFIELD.

Westfield, Massachusetts, in long. 72° 25' N., lat. 42° 6' N., is on flat land along the Westfield River. Settled in 1658, it was incorporated in 1669.

Water-works were built by the town in 1874, after the plans and under the superintendence of L. F. Root, C. E., with Shedd and Sawyer as consulting engineers. The supply is taken from Moose Meadow Brook, which has a water-shed of 4 square miles.

An earth dam with stone masonry heart wall, 850 ft. long, 30 ft. high, and 8 ft. wide at bottom, and 2 ft. at top, creates a storage reservoir of 38 acres area and 184,000,000 gallons capacity. A waste channel 20 ft. wide was excavated around one end of the dam. This is paved with stone, and has cut-off walls across its bottom. A 6-in. pipe at 5¼ ft. below water level, and a 20-in. pipe at the bottom, extend through the dam. This reservoir is 918.68 ft. above sea level, and 771.89 ft. above the town.

The water flows from this reservoir through the rocky channel of the stream to Tekoa reservoir, formed by building a masonry dam 198 ft. long, 14½ ft. thick at bottom, 7 ft. at top, and 29 ft. high. Another wall is built across the bottom of the ravine 50 ft. above the dam, and the intervening space filled with puddle. Two openings enable water to be drawn 5 or 15 ft. below the surface. This reservoir has 1½ acres area, and holds 4,000,000 gallons, at 292 ft. above the town.

A 14-in. cast-iron pipe conveys the water 4 miles to the town, passing under the Westfield River in a trench excavated in the rocky bottom. There are 21 miles of cast-iron distribution pipes of from 14 to 4-in. diameter, with 116 fire hydrants, 105 gates and 787 taps.

The population in 1880 was 7,641. No record is kept of the consumption.

The works have cost $250,000, which is also the amount of the bonded debt, bearing 6 and 7 per cent. interest.

The receipts have been $56,856. The expenses in 1880 were $1,300, and the receipts $9,281

The works are managed by three Water Commissioners. W. S. Bush has been the Superintendent since 1876.

THE GUIDET PAVEMENT.

(Correspondence of the Brooklyn Eagle.)

WASHINGTON, March 15.

To-day, for the first time in her history, Brooklyn came before the Supreme Court of the United States as a litigant. It was in the case of Charles Guidet against the City of Brooklyn. George Harding appeared for the apellant, and Messrs. George Gifford and William C. DeWitt for the respondent.

The case involves the validity of the patent held by Guidet—a kind of stone pavement now lying on Broadway, New York, and on Fulton street, Brooklyn. He claims that his patent has been infringed by the City of Brooklyn in the construction of a similar pavement on Myrtle, Atlantic and Lafayette avenues, Henry street and other thoroughfares.

The cost of laying the pavement on Fulton street was something over seven dollars a square yard, while, after the rejection of the patent by the city, the same kind of a pavement was laid at a cost of less than three dollars per square yard under a general computation. The pavement is considered the best style of pavement for populous cities that has yet been put in use, and the question of whether it can be laid by free competition or shall be controlled under a patent is of the utmost importance to all cities lying near the vicinity of the common rock of formations from which the stone is quarried.

Should it go against Brooklyn, the damages to be recovered by Guidet under the liberal rules governing patent rights, and in view of the extensive use, irrespective of the patent, would amount, it is believed, to several hundred thousand dollars. Should it be decided in Brooklyn's favor, not only would these large damages be avoided, but a gain in the economics of street pavements of the largest consequences, for the present and the future, would be established for Brooklyn, and by Brooklyn for her sister cities in the several States.

The suit was first brought in January, 1874, and after a long series of meetings and taking of testimony in Brooklyn, Rochester, Buffalo and elsewhere, the case came on for trial before Judge Blatchford, in 1878, and was by him decided in favor of the city, on the ground that Guidet's alleged invention was not a novelty at the time of his issue of letters patent, but was contained in substance and principle in pavements laid down in Rochester and Buffalo thirty or forty years ago.

ARGUMENT FOR APPELLANT.

Mr. Harding, in his argument, took the ground that the patent was not void for want of novelty. He claimed that the pavements which the defendant had shown to have been constructed in Boston and New York were essentially different in character from those covered by the Guidet patent, and that that laid in South street, New York, was suggested by Guidet himself.

In regard to the Buffalo and Rochester pavement, counsel had transported to the Supreme Court a great load of specimens of stones taken up from the streets of those cities, and claimed that these samples demonstrated the difference in character from that covered by Guidet. He compared specifications of the contracts for laying the pavement on Lafayette and Myrtle avenues in Brooklyn, with the letters patent of Guidet to show that those contracts call for the laying of the pavement thus patented, which he insisted differed from the pavement in use prior to the patent in other cities named, and to show the similarity between the pavement laid in Brooklyn and that covered by the patent, he read at length in testimony.

He insisted that the subject matter of the specifications and claim of the letters patent to Guidet did involve invention. Continuing he said:

A good, firm and durable pavement was greatly desired and needed, and a prime necessity in the great streets of our large cities; and it is a matter of public notoriety and of public scandal, how pavement after pavement had been tried on such streets only to be taken up and replaced by a new venture. Of all the streets in the country, Broadway, in the city of New York, probably stood in greatest need of such a pavement, and here the weakness and faults of one pavement after another were fully demonstrated, until in 1872 Guidet placed upon it his patented pavement, which still remains there, and which was found entirely capable of standing even the tremendous test to which it has there been exposed. Since Guidet's demonstration of the value of the pavement, and how enduring it was even under the travel of Broadway, it has been followed in Brooklyn and by other cities. If Guidet's pavement is no advance upon the Nicolson pavement described in the specification, why does not the city of Brooklyn lay its pavements in that way? On looking back it seems very simple to obtain the open joints of the Nicholson pavement, by roughing the transverse sides, but no one prior to Guidet conceived the idea of making pavements of blocks having the general figure of a parallelopipedon, and having their sides, which were laid transversely to the streets, purposely left or cut rough so as to form such a joint. In all the voluminous proof taken by the respondent, they did not go one step beyond the admissions of the patent as to the prior state of the art.

I submit to your honors that he did a new thing and is entitled to the patent for just what he did do.

ARGUMENT FOR RESPONDENT.

Mr. DeWitt followed in an elaborate and carefully prepared argument, and delivered it with strong effect, considering the importance of the subject and the interest excited by it in Brooklyn. Your correspondent has given considerable space to his remarks, which were substantially as follows, though questions developed many spicy answers as the orator warmed into his subject:

The reissue patent on which this suit is brought is void for want of novelty. The pavement in extensive use in the cities of Rochester and Buffalo long before the time of the alleged invention of Guidet was substantially the same as that attempted to be described in the reissue patent. All that can be covered by this patent, under any construction possible to be put upon it, is that it is for a pavement made of stones of substantially the general form of parallelopipeds, having the end joints relatively close, and the side joints relatively open, for the purposes specified in the patent. Now, all of these conditions were exactly fulfilled by the Rochester and Buffalo pavement. Those pavements had the end joints of the stones relatively as close, and the side joints relatively as open, and for the same purpose as is specified in the patent, and as much so as any pavement which tha proofs show was ever laid down in the city of Brooklyn. It was the practice in Rochester and Buffalo for foremen and superintendents of paving to instruct the pavers to so lay the stones as to form open side joints transversely to the streets, and so as to form close end joints in line with the streets. After such instruction was publicly given and understood to have been acted upon, why was not that alone sufficient to show that what was so directed to be dona was a matter of common knowledge? How could it be said that that remained to be discovered which workmen had been repeatedly directed to do with a full understanding of the object and utility of having it done? This piece of testimony alone would be sufficient to invalidate the patent under consideration. The Guidet patent purports to be for a pavement possessing certain properties, and not for the materials composing the pavement. Any peculiarity specified in the material is merely to contribute toward the properties which the pavement is to contain after it is laid in the street. The properties, as far as the patent defines any which characterise the pavement, are:

First—Stones bounded by six faces, each two opposite faces being parallel with each other.

Second—The width of the joints running transversely to the streets are comparatively wide.

Third—The width of the joints running longitudinally to the street are comparatively narrow.

On the part of the appellee twenty-two witnesses testify that the Rochester and Buffalo pavements consisted of stones which were substantially as thick and as long on the bottom as on the top, and substantially as long on one side as on the other, and substantially as wide and as thick on one end as on the other, thus bringing them as nearly to the form of parallelopipeds as the stones in the alleged infringing pavement are proved to be or claimed to be. On the part of the appellee twenty-nine witnesses testify that the joints running longitudinally with the line of the streets are substantually close when compared with the transverse joints. On the part of the appellee, twenty-nine witnesses testify that in the Rochester and Buffalo pavements the joints formed by the sides of the stones and running transversely to the line of the streets are substantially open when compared with the longitudinal joints.

Mr. De Witt criticised at length the plaintiff's testimony and submitted: That in view of the testimony of the Rochester and the Buffalo pavements, the court below was right in holding that the prior use of the pavements laid down in Rochester and Buffalo prior to the date of the alleged invention of the patentee was sufficient to invalidate his patent. He argued that the reissue patent is not for the same invention as was the original, but is for another and different invention, and that fact appears from a comparison of the original and the reissue specifications, and that the claim of the Guidet reissue is not for patentable subject matter. But Mr. De Witt laid the greatest stress upon the point that there was no invention or discovery required in producing the subject matter patented by the reissue patent. The patent for that reason is, therefore, null and void. There is a definable and a defined class of things, which are the products of inventive genius, and a class which are tha products of merely mechanical skill, and others which are so obvious as to require neither genius nor skill to produce them. In effecting changes in articles and materials employed in useful arts, two functions of mind are employed. One is the inventive faculty, and the other is mechanical skill. They are the genius of the inventor and the skill of the mechanic. It is often difficult to trace the line between the products of the two, and to determine where the skill of the mechanic leaves off and the genius of the inventor begins. But, notwithstanding that difficulty, the two have a distinct existence, a distinct operation, and produce distinct results, and this has been repeatedly affirmed and acted upon by all courts, both in this and in foreign countries. The following propositions are well settled law, and cannot be denied:

First—That the products of mere mechanical skill are not subjects for patents.

Second—That the products of inventive genius are subjects for patents.

In determining to which class the change belongs reference must be had to tha effect as wall as the means. No changes or improvements which are obvious can rise higher in dignity than to belong to the products of the mere skill of a person acquainted with the art or manufacture to which the change belongs; and, as already stated, there is a class of changes which are so obvious and so low in the scale as not to require even skill. In considering whether or not the laying of such a pavement as that described in the Guidet patent required anything more than mechanical skill, three things are to be noticed:

1. The functions or properties of the pavement to be produced.

2. The form of the material—that is, the form of the stones to be used.

3. The manner in which tha stones are to be laid—that is, their relation to each other.

First—As to the functions or properties of the pavement to be laid.

It must have comparatively tight joints longitudinally, and comparatively open joints transversely. These requirements were for the purpose of preventing ruts being worn by the wheels of vehicles, and to furnish foothold for draught animals. There was no discovery in either of these objects or uses, and none is claimed in behalf of the patentee. Everybody knew that it was useful to prevent horses slipping on the pavement, and useful to prevent ruts being worn into the pavement. There was no invention or discovery in the means proposed to attain these objects. Everybody knew that to prevent wheels wearing ruts between pavement stones tight joints in the direction of the travel of the wheels were the appropriate remedy. This had been familiar knowledge to persons using or observing the use of wheel vehicles as long as such wheels had been used. Everybody knew that open joints crosswise of the streets were the proper means of furnishing foothold for draught animals. This had been familiar knowledge as long as such animals had been used.

Second—As to the form of the material—that is, the form of the stones to be used. There was no novelty in the general form of the stone blocks to be used. If restricted to the form of a parallelopiped, there was no novelty in it, for that was the form of an old well-known mathematical figure, and it was also old in its application to pavement stones, as is proved by the appellee and also admitted by the appellant's patent.

The objects to be attained requiring no discovery, but being matter of common knowledge, and the direction and size of the joints adapted to the attainment of those objects requiring no contrivance or discovery, but being also matter of common knowledge, and the form of stone blocks adopted involving no novelty, it follows that all that remained to be done to produce the pavement patented was to use the appropriate and well-known means of making the longitudinal joints comparatively tight to resist the wearing of ruts, and the transverse joints comparatively open to furnish foothold for draught animals.

Third—As to the manner in which the stones were to be laid—that is, their relation to each other.

Everybody knew that when the surfaces of stones or the surfaces of anything else are to be put in contact, if smooth, they will make a tight joint, and when a tight joint is to be made, everybody knew that smooth surfaces were the proper means of making it. Everybody knew that if an open joint is to be made between the surfaces of stones, or the surfaces of anything else, and that such surfaces are not to be separated by any other material being interposed between them, protuberances on those surfaces are the appropriate means of producing the required joints. The use of such means of producing close and open joints was simply using well-known causes to produce well-known effects, merely doing what was well understood and had been practiced upon for centuries. Again, comparing the patented pavement with the pavement which the patent itself admits was old, shows that there was no patentable invention in the former. What does the patent admit was old? The specifications of the reissue contains the following admission, page ——: "I am aware that pavements have been produced of blocks made in the form of parallelopipeds, but in order to produce open transverse joints, it was found necessary to interpose between the adjoining blocks thin strips of wood or stone." Here, then, is an admission that a pavement was known composed of blocks in the form of parallelopipeds; that it had open transverse joints, and that it was so laid as to intentionally produce open transverse joints. This of course means that the transverse joints were more open than the longitudinal joints. Therefore, the pavement admitted to have been old at the time of Guidet's alleged invention was composed of the same blocks, had the same relative width of joints as the pavement claimed by Guidet. Now, what remained to be done to that old pavement to make it precisely the pavement patented by Guidet?

The only difference between that old pavement and the Guidet pavement is that in the latter the part which separates the sides of the stones to secure an open joint at the top is fast to the side of the stona, while in the old pavement, that part is there, having the same function and doing the same duty, but is not fastened to the side of the stone. It was preposterous to assert that this difference involved the exercise of inventive genius. Mr. DeWitt argued also that no infringement had been proven, and that if there had been the city of Brooklyn is not liable for the infringement of letters patent by its officers, but redress must be had, if at all, against the officers themselves.

Mr. DeWitt in concluding said he rejoiced to be able to close so long a term of service in so good a cause before so grand a tribunal and on the eve of assured success. Cope.

LITERATURE.

"History of the Water Supply of the World," by Thos. J. Bell, Assistant Superintendent of Cincinnati Water-works.

The above somewhat pretentious title is calculated to raise the expectations of the reader, which the treatment of the subject fails to satisfy.

While there is a large body of information introduced from various sources, it is frequently quite conflicting, and the items introduced with so little connection or relevancy to the matter in hand as to resemble a scrap book of clippings without method or system of arrangement. An index, however, is added which gives a value to the publication as a book of reference.

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NOTES.

Cost of Right of Way in England.

Last year a well-known English railway had to buy several pieces of land along its line, and the cost of the transfers furnishes a startling example of the need for reform in conveyancing methods in England. For the land itself a total sum of over $635,000 was paid, for conveyancing charges the company paid an additional $74,500. A piece of land at Bradford cost $16,000; the legal charges on it were $4,960. A piece at Tapton cost $10,000; the charges were $605. Elsewhere some land cost $6,520, and the expenses were $2,840, while there was one case where the charges exceeded the purchase price, being $496 as against $431.

New Building Law.

The new building law now before the New York Legislature is a great improvement upon those now existing. It aims to adapt the regulations of the statute to the most recent improvements in architecture and building, and to remedy the numerous mischiefs recently discovered through falling or condemned buildings or fire and the loopholes in summary procedures. For instance, the new law takes notice (which the existing law did not apparently) that buildings for commercial purposes, and even for some residential purposes, were constructed nine, ten and even eleven stories high, and the new provisions adapt thickness of walls more closely to height. The new statute provides for more securely bracing unlopped walls; it forbids mason work in high freezing weather, it provides for lining elevators with iron, and openings at their tops for escape of fire and smoka if these come; for iron or stone steps in high apartment houses or in buildings used for offices; it regulates the safe distances between beams and flues and provides for a heavy lining of flues; it calls for a more perfect testing of iron columns before these are set; it provides for the instantaneous search in ruins for wounded or dying persons, and it takes away much existing looseness of provision as to fire-escapes. The new bill contains exceedingly elaborate enactments as to theatres and places of public resort in building matters. Several sections provide for summoning a jury to try any question as to safety disputed between owners or builders, or either or both, with the building authorities, and in unforeseen cases gives semi-autocratic power to the Inspector and makes the elasticity of the law depend upon tha discretion of the head of the building bureau.

Electric Lighting of Railroad Cars.

It is interesting to know that Charles E. Buell, of this city, has recently been awarded letters patent for devices for so controlling electrical storage as to overcome the difficulties encountered by the electrical engineers of Europe, and make the lighting of not only railway trains, but isolated residences and thickly-settled communities by stored electricity not only practicable, but very desirable, his patents obtained, and to be obtained, securing to him every part of an electric lighting system. He thinks a dynamo-electrical machine of two horse-power amply sufficient for lighting the longest railway train by stored energy, and that such machines can be supplied for less than $200 each. He is having an improved form of dynamo machine built at the factory of James Buell & Son, Woburn, Mass., which he thinks will produce a current equal to that produced by 600 cells of the Grove battery, when propelled by a two horse-power motor. His system for railway trains requires no attendance or skill in connecting, in turning on, or off, and requires no replenishing of material consumed. It has been demonstrated that the incandescent lamp will last very much longer at a higher luminosity when used with currents from stored electricity, as compared with currents direct from the dynamo machine. The light emitted from the lamp being due to vibratory motion of the particles of the exceedingly frail filament of carbon and the jerky motion of the propelling engine results sooner or later in rupture of the filament.—*New Haven (Conn.) Palladium, March 28.*

RIVETED GIRDERS.

BY ALBERT F. HILL, C. E.

The riveted girder may be properly considered the intermediate structure between the rolled beam and the framed truss; it finds its first application in those cases where either span, or load, or both, begin to exceed the availability of the rolled beam, and is often found to be preferable to the framed truss, where, from lack of room, we are obliged to make the ratio of the height of a truss to the span small, and where the load to be carried per lineal foot of structure is great, as, for example, in short span railroad bridges.

Considering the important part which plate girders have in our railway service, and that they necessarily partake of all the defects which riveted work in general is heir to, a few remarks in relation to the prevalent methods of dimensioning and manufacturing these structures will hardly require any apology.

Whatever method of calculation may be preferred by the individual designer, it will probably be conceded that no material error is committed by the conception of a plate girder as a truss in which the flanges perform the functions of the upper and lower chords respectively, the moment of the flange stresses resisting the bending moment; and in which the web members are so slight in the dimension transversely to the truss, that their other dimension fills the whole web, as represented by the web-plate, which has now to resist all of the shear.

In dimensioning the flanges for such girders the allowable safety strength of iron is in accordance with the service for which the girder is designed, variously fixed at from 12,000 to 8,000 lbs. for extreme fiber strain, but very rarely, if ever, is this variation of safety factor observed in dimensioning the web against shear. As a result of this, we find in many cases the web-plate made too thin—and though "stiffeners" may be introduced to prevent failure from side-buckling, they are no remedy for disproportionate pressure upon the rivet area, nor protection against the more rapid deterioration from rust of very thin plates.

The web-plate should be thick enough to resist the shear at the abutments, as well as compression at an angle of 45°, equal in amount at any section, to the shear at that section.

The experiments of Regnault, Wertheim, Spangenberg, confirmed by later experiments of Kirkaldy, Thurston and others, fix the ratio of shearing to tensile strength at $\frac{4}{5}$. A series of experiments made by the writer on iron plates intended for girder webs gave the average ratio $\frac{357}{448}$ or almost exactly $\frac{4}{5}$.

The determination of the thickness of the web will follow from the following considerations, viz.:

The horizontal stresses being proportional to the distance from the neutral axis, are less at every point of the web-section than in the outside fibers of the girder section, and therefore covered by the allowable strain. The horizontal shear H at any section x of the web is greatest at the axis, and designating by h the effective depth of the *girder*, we have

$$H = \frac{max.\ S_x}{h}$$

the horizontal shear per unit of height; and calling C the allowable tensile strength of plates, the thickness of the web b will be determined by the equation

$$b \times \frac{4}{5} C = \frac{max.\ S_x}{h};$$

$$b = \frac{5\ max.\ S_x}{4\ h\ C}. \quad (1)$$

a thickness sufficient to withstand the horizontal shear at every distance from the axis.

Since the horizontal shear at any section is equal to the vertical shear at that section, the thickness b of the plate will suffice for both horizontal and vertical shear at every point from the axis.

But since b, the thickness of the plate, is uniform in the same girder, therefore a constant, it only remains for us to see under what conditions the term $\frac{max.\ S_x}{C}$ will become a maximum.

Designating by w the dead load per lineal foot and by w the live load by lineal of girder, we know that

$$S_{min.} = \frac{w\ l}{2}; \text{ and } S_{max.} = \frac{(w + w)\ l}{2};$$

are the limiting values of the shearing stresses, and as the shearing stresses are always greatest at the points of support we shall obtain the greatest value for b by substituting $\frac{(w + w')l}{2}$ for max. S_x and making $C = 9{,}000$, we obtain by substitution in equation (1)

$$b = \frac{5(w + w)\ l}{8\ h\ C}; \text{ or}$$

$$b = \frac{(w + w')\ l}{14{,}400\ h} \quad (2)$$

for web-thickness against shear.

Equation (2) may be simplified by substituting the total depth of girder for the effective depth, making $h' = \frac{9}{10} h$, which gives

$$b = \frac{(w + w)\ l}{12{,}960\ h'} \quad (3)$$

Side-buckling has thus far eluded investigation, and it is doubtful if any increase in the thickness of the web-plate beyond that necessary to resist shear would be as good practice as the use of vertical angle irons as stiffeners.

Deserving of more attention though than any methods of calculations are the methods of manufacture adopted in so many shops for the turning out of riveted work. The writer has visited—and therefore speaks from personal knowledge—establishments engaged in turning out riveted bridge work, the entire plant of which would have hardly sufficed for an ordinary boiler repair-shop. When it is considered that very few companies think they can afford an inspector at works, that even the most concientious and strictest of inspectors could not watch the work so closely that no imperfection should escape him, that the very concerns who lack most in facilities for doing proper work are the very ones who are always ready to bid lowest, it is not to be wondered at that riveted work is being looked upon with more and more distrust.

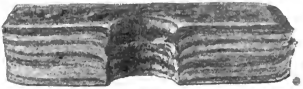

FIG. I.—SECTION ⅝-IRON, HOLE PUNCHED, ENDS SHEARED.

In the first place, it will be found of very common occurrence that the holes of contiguous parts do not *match*. In order, therefore, to admit the rivets, the ever ready drift-pin, and, perchance, even the cold chisel are resorted to. Now when it is remembered what excessive distortion of fiber the punching causes anyhow, and that even the best mode of riveting—power riveting—also distorts and opens out the fiber in the rivets, it will be seen how necessary it is to avoid the development of initial strains, which are entirely beyond computation.

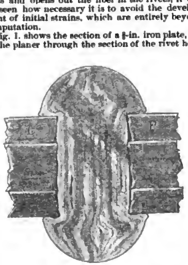

FIG. II.—IRON RIVET—PUNCHED HOLES.

Fig. I. shows the section of a ⅝-in. iron plate, cut in the planer through the section of the rivet hole, the ends sheared off, and the planed surface treated with acid to develop the fiber. Fig. 2. and Fig. 3. are sections of rivets and plates cut in the planer and the rivet sections only, treated with acid. The rivets were driven by power—and carefully driven—yet the punched holes in the three contiguous plates (Fig. 2), although matching perfectly, show what distortion the rivet has undergone, and how far it is from "filling the hole." Fig. 3. shows the rivet driven through punched holes, enlarged by the reamer. The difference in the result is too striking to need much comment, beyond pointing out the inevitable distortion of fiber in the rivet, and the fact that the rivet seems to have shrunk from the hole. Out of 24 rivets, driven in drilled and in reamed holes, 17 were found, on cutting them out in the planer, to have sufficiently shrunk from the hole to admit of being taken by hand. These inherent defects in the best kind of riveted work are fully recognized abroad, and the best shop-practice there insists upon drilled holes in riveted bridge-girders.

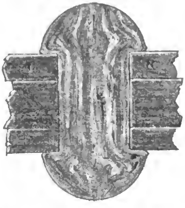

FIG. III.—IRON RIVET—REAMED HOLES.

This does away also with the separate laying out of the holes on each piece from wooden templates—the principal cause of the non-matching of holes—since drilled holes admit of the assembling of the different parts by means of clamps, and the simultaneous drilling of the contiguous parts.

To show the relative influence of punching and drilling upon iron plate, the experiments made by the "Master Mechanics' Association" are given here:

Specimens 1.75 in. wide, ⅝ in. thick, diam. of hole ¾ in.	Method of rupture.	Load per sq. in. of cross section.	Load per sq. in. of rivet cross section
1. Entire plate......	Plate torn.	60,000	
2. Plate with drilled hole	Plate torn.	50,470	
3. Plate with punch'd hole................	Plate torn.	38,431	
4. Single riveted hole drilled..	Rivet sheared.	47,000	53,350
5. Single riveted hole punched	Plate torn.	50,100	57,570

The bad effects of punching become still more noticeable in steel plates.

Experiments 4 and 5 show that the rivet in the drilled hole bore about 9 per cent. less than in the punched hole. This difference must be ascribed to the sharper sides of the hole, which exercise a cutting action. This is also shown by the experiments of Sharpe and Kirkaldy, in which the same rivets in a steel plate showed much less resistance than in an iron plate. Fairbairn confirms this, having observed that the rounding off of the edges in drilled holes gave an increase in strength of about 12 per cent., but in punched holes only 2½ per cent.

Considering all these defects in riveted work, especially such as is produced by the ordinary methods of manufacture, it becomes evident that engineers must rely more upon the standing, facilities, and grade of workmanship, of the concern from which they get riveted work than upon inspection. A neatly-formed rivet head tells no tale until the mischief is done.

Careful calculations, strict insistance as far as possible upon full compliance with specification, and 20 per cent. more factor of safety for riveted than for pin-connected work will probably prove the best protection against "unforseen accidents."

ENGINEERS' SOCIETIES.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting on Tuesday, March 14, Sir. J. W. Bazalgette, C.B., Vice-President, in the chair, the first read was on "The Design of Structures to resist Wind-Pressure," by Mr. Chas. B. Bender. It was observed that wind-pressure was as often overrated as underrated. Instruments to measure the velocity and force of the wind were not very reliable, on account of the frequent change of direction of the wind, and of its action by sudden gusts, and not by mere statical pressure. The most trustworthy experiments, made with falling plates by General Didion, yielded pressures of 40 lbs. per square foot, on a test plate having an area of 10.76 square feet, for a velocity of 111 miles an hour. The size of the test plate was very material. Had Didion used plates 12 inches square, the pressure would have been only 32 lbs. The form of surface exposed to the wind was also of importance. Hollow cups experienced double pressures, cylinders only one-half of the test pressure, and there were forms which reduced it to less than one-fourth of that on a flat plate. Since hurricanes generally acted with great lifting power, in calculating the wind-pressure upon a structure, the most dangerous direction of the wind must be considered. For bridge floors wind coming from below at an angle of about 25° was the most trying. Now, assuming the wind to blow in this direction and a little from the side, the total opposing surface of a structure, having regard to the size, position and form of its members, and, in the case of railway bridges, carrying a light passenger train on the floor, must be considered. Engineering structures must be so built that there should not be any movement, either of shifting, turning on a pivot, or tilting of the whole structure. Further, lateral and transverse wind-bracing must not be strained beyond one-third of the calculated breaking strain. Since the horizontal wind-bracing might experience strains from the vertical loads those strains must be deducted from the specified maximum; and it would be found that for short spans there would remain available for wind proper, 5 tons, and for large railway bridges, 6 tons per square inch of lateral wind diagonals. The transverse bracing might be influenced by the vertical loads, and it must likewise be designed to stand strains arising both from wind and from moving loads. The wind-pressure of the top lateral bracing of a bridge had to be carried to the lower floor, and each end must be sufficiently strong and stiff. As regarded details it was essential to provide strong plates or pins for joint connections so as to absorb additional or secondary strains upon the members. In the case of eccentric connections, the moments of flexure arising from the application of forces must not be neglected, and there should be members strong enough to transfer the wind-strains to the central joint. Iron piers, also long-span bridges, must be carefully examined as regarded tilting, and the danger must be met by giving a sufficient base, or by anchoring to heavy blocks of masonry, well proportioned and well executed, or by both of these methods. The consideration of the action of wind materially influenced the proportion of the width of a bridge to its depth, and the latter was limited long before the maximum height was reached, as regarded vertical loads, in a bridge of most economical design. For instance, in a girder bridge of 400-ft. span and 18 ft. wide, the truss could not with safety be deeper than 45 ft.; if built 50 ft. deep, a width of 21 ft. was advisable. As the force of the wind upon a large railway bridge amounted to about the load of an ordinary train, it followed that its design for carrying vertical loads was only part of the problem to be solved. Bridges and similar structures, if equally well designed in both directions, horizontal as well as vertical, were satisfactory, and they would not be so unless this were done.

The second paper was read on "The Resistance of Viaducts to Sudden Gusts of Wind," by Prof. Jules Gaudard. In order to ascertain the stability of a structure exposed to wind, it was necessary to find the greatest pressure to which it might be subjected by sudden squalls. The maximum wind-pressure in England had been stated by Rankine to be 55 lbs. on the square foot, but a pressure of 71 lbs. was observed at Liverpool in September 1875. Tornadoes in America were reckoned to have exerted pressure of from 84 to 93 lbs., though allowance for pressures of only from 33 to 50 lbs. was made by American engineers in designing bridges. In order to procure more precise data, it was urged that suitable apparatus should be at once established, in various places, for recording the pressures attained during severe gales. Suspension bridges, owing to their flexibility were most affected by wind, as evidenced by injuries inflicted by gales on the Roche-Bernard and Menai bridges. This class of bridge had been stiffened by additional cables from the top of the piers to the roadway, by stays underneath, by cross-bracing between the suspension-rods, by stiffening the sets of chains themselves, or by spreading out the cables laterally at the tops of the piers. Thibault found that with two square screens placed at the distance apart of one of their sides, and one completely covering the other, the wind-pressure on the two screens was 1.7 of that upon the exposed screen. The pressure, however, upon two plate-girders connected by a platform was evidently less, and when the roadway was at the top or bottom of the girders might be reckoned as 1.2 of the pressure on the windward girder. In the case of trellis-girders, each opening might be regarded as an orifice with thin sides, in passing through which the stream of wind experienced a certain amount of contraction, which occasioned a somewhat greater resistance than the proportion of solid to open would indicate. An arch had the merit of opposing less surface to the wind in the central portion of the span; whereas, the reverse was the case with a bow-string. Two narrow iron-arched bridges of large span at Oporto and Montereale had been secured against the wind by special contrivances; the first, by spreading out the iron ribs toward the springings, so that the ribs, though only placed 18 ft. apart at the crown, were 49 ft. apart at the springings; and the second, by placing side buttresses against the haunches of the arch, thus providing a wider base. Trains passing along a lattice-girder bridge increased the surface exposed to the wind. In the case of high viaducts, the greatest strain was thrown upon the anchorage of the piers. The strains upon the Bouble viaduct, having lattice-girders and braced iron piers 189 ft. high, were investigated, and it was shown that in the extreme case of a wind-pressure of 55.8 lbs., and a train on the viaduct, a strain of 348½ tons would be thrown on the anchorage. The strain on the anchorage might be provided for, either by stays fastened near the tops of the piers and secured to the ground, or by widening out the base of the piers by buttresses. High timber stagings, with their broad surfacings, were specially exposed to damage from wind, but they might be effectually braced by iron wire cables. The force of waves, beating against very exposed structures, appeared occasionally to have attained a pressure of about 6,000 lbs. per square foot, but in general the shock of waves was estimated not to exceed from 600 to 1,000 lbs. Even with this latter pressure, the blow of the waves against the lower portion of a lighthouse was more to be dreaded than the pressure of the wind above, unless the tower was exceptionally high. On the contrary, in the case of a high viaduct, the effect of the wind on the lofty superstructure was more dangerous than the beating of the waves against the narrow piers.

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AMERICAN SOCIETY OF CIVIL ENGINEERS.

The Society met at its house in Twenty-third st., New York, Wednesday evening, April 5, 1882, President Ashbel Welch in the chair. The following candidates were elected members: Lieutenant William H. Bixby, Corps of Engineers, U. S. A.; F. A. Calkins, New York; J. M. Knap, New York; Chas. P. Perkins, Williamsport, Pa.; B. Rhodes, Niagara Falls; Robt. Surtees, Ottawa, Can., and Associate Member, John Lockwood, New York. Arrangements were made for the annual convention of the Society, to be held in Washington, May 16, prox., and succeeding days. The introduction of a bill in Congress was announced for establishing a commission composed of persons skilled in the investigation, production and use of metallic substances and other structural materials. The great importance of the speedy passage of this bill to the future safe and economical construction of bridges, roofs, floors, iron or steel ships, ordnance and armor, and all structures in which metal is extensively used, was forcibly presented.

A paper by A. P. Boller, M. Am. Soc. C. E., on the Mode of Underpinning adopted for the Croton Lake bridge, New York City and Northern Railroad, during the repairs to the masonry piers, was read by the Secretary. This bridge was a single track, wrought-iron, deck structure in three spans of 160 ft. each, with skeleton wrought-iron piers or towers springing from blocks of masonry. The water was 80 ft. in depth. These towers had four legs and thus concentrated all the weight upon the four corners of the masonry. This masonry had been built ten years before by another company. It rested below low water upon timber cribs. It was tested by loading with stone before building the iron bridge, without showing improper settlement. The erection of the bridge towers and the use of the bridge soon developed the fact that the masonry could not stand the weight upon its corners, and it became necessary to rebuild it. The tower being continuous framework, with spreading legs, made it practicable to build inside of them a subsidiary wooden tower, with perpendicular legs. This was done, the bottom wood sills being placed so as to admit the introduction of eight 20-ton hydraulic jacks. Two-minutes' work with the jacks lifted the towers and adjoining spans bodily. They were then supported upon 15-in. rolled beams, 200 lbs. to the yard, placed in pairs, resting on the inner side upon timbers distributing the weight upon the masonry and on the outer side on timber supports built up from the original crib work. The defective masonry was then taken out and rebuilt. One-half hour sufficed to raise the structure, throw the weight upon the cross girders and resume traffic. No train was delayed on its schedule time. The author criticises severely the character of the old masonry.

The subject of the overflow of the Mississippi was also discussed.

A MODEL CITY GOVERNMENT.

If to love light rather than darkness is an indication of good conduct, the government of the city of Berlin must be excellent. Those to whom it is intrusted appear to take satisfaction in exposing their every act to the widest publicity. Account is rendered to the whole world of expenses and receipts to the last pfennig, of the motives which have guided the authorities in their past actions, of their future plans and of their methods, the names, addresses and functions of all concerned in the administration of the city are published, the citizens are instructed in the city constitution, the relations of city to state, and the changes which the city fathers think desirable.

In the "Personal-Nachweisung der Berliner-Gemeinde Verwalthung," information is given in the fewest words concerning the location, purposes and officers of every city institution, as well as the names and duties of all those who in any way take part in governing the city. It is to the city what a register or catalogue is to a university or college. Like the other publications of the city, it may be purchased of any book dealer for a moderate price. The director of the statistical bureau of the city publishes every year "Das Statistische Jahrbuch der Stadt Berlin." This contains the city's annals expressed in figures. It is to the city much the same as a well-kept diary would be to an individual, if the events it described were arranged and classified at the close of the year. It is a work of scientific value, which shows in a surprising manner how much useful, curious, and at the same time highly interesting information can be conveyed in tables of figures. But the most valuable of all the city's publications are the reports of the magistracy. Four of these reports have been published. The first, appearing in the year 1842, described the administration from 1829 to 1840; the second, appearing in 1853, embraced the years 1841 to 1850; the third, published in 1863, treated of the decade from 1851 to 1860. The fourth report is the one of which we shall treat in this article.

The preface to the Report on the Administration of the City of Berlin, from 1861 to 1876 inclusive, describes the motives which have led the magistracy to publish it. It is hoped that it will be useful to the authorities of other cities, inasmuch as it furnishes the means of comparing different methods of striving for the same goal. It aims, further, to instruct citizens and officers who have only lately begun to take a part in the government of the city, in the work which has been already accomplished by the several branches of the administration, and to point out clearly the yet unsolved problems which arise from the concentration of a great number of men within comparatively narrow limits. The concluding paragraph of the preface to the third volume shows how clearly the city fathers have conceived the central idea of good government, and how earnestly they are endeavoring to fulfill their duty toward the city. They state that they have written a report which will find, they trust, numerous readers among the citizens—those who are simply voters as well as office-holders—and will lead to a better understanding of municipal affairs in wide circles, since the success of the future administration of the city depends to a great extent upon the earnestness and intelligence with which the Berlinese interest themselves in city institutions, and the fidelity with which they discharge their functions as citizens. Such openness and honest sincerity on the part of city authorities impress one who, like the writer, is a New Yorker, with a strange feeling of unreality. In fact, in reading many parts of this admirable report, one finds it difficult not to believe that it is a description of some city government in Utopia. Can the New Yorker realize the fact that there is a city where the streets are kept clean at a moderate cost, and the work done between midnight and morning so as not to interfere with traffic; where snow and ice are removed from the highways thoroughly and with dispatch;* where the streets are well paved or are being paved, and in such solid, substantial manner that it seems as if the pavement must last for generations; where the city is well lighted without any gas-company quarrels; where the city gas works are so well managed that they yield a surplus equal to nearly a tenth of the net revenue of the city from all sources; where there are no rings; where there are no defalcations or thefts on the part of city officials; where there are no fat contracts; where there are no street-paving jobs and no neglected parks? Although a New Yorker might smile incredulously at the statement, there are such cities, and Berlin is one of them. A study of the administration of Berlin may assist us in discovering means to abolish the misrule to which we are subjected.

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* The writer has already described the methods and expenses of street cleaning in Berlin in an article published in the *Evening Post*, April 6, 1881.

It can scarcely be more difficult to govern New York than Berlin. Both cities are of nearly the same size and both have grown rapidly. In 1829 Berlin had a population of 242,000; in 1880 one of 1,118,630.—*The Nation.*

CORRESPONDENCE.

GRANITE PAVING BLOCKS.

ST. LOUIS, April 4, 1882.

EDITOR ENGINEERING NEWS:

SIR: On page 111., No. 13, you give prices for granite paving blocks for Boston thus, 100,000 blocks at $45.98 per 1,000—or—100 000 at $49 per 1,000, etc. In connection with this information, it will be very interesting to learn something relating to the specifications for the blocks, as they cannot be expected to be all alike in size or shape. Boston specifications for preparing the bed of the street and putting down this kind of pavement will be read with much interest also.

[We insert the above trusting that some of our Boston friends will supply the needed information.]

THE OUTLOOK FOR ENGINEERS.

RICHMOND, Va., April 4, 1882.

EDITOR ENGINEERING NEWS:

Upon my arrival in this city, a few days ago, I received, with great pleasure, from home, ENGINEERING NEWS for March.

On reading the article of the 18th on the "Outlook for Engineers," and your advice to go South, thinking that some worthy members of the profession may be misled by it, I can't refrain giving them, through your paper, my observations upon the subject.

After an extensive tour over the section, I find there a great many competent and experienced native-born engineers ready and willing to take *hold of* any kind of work, and it would be next to impossible for a Northern engineer to get city work, as politics come in play there; so railroad work is his only hope, and then he must get his appointment through some stockholder of a road in the South, at home. Most of the engineers from the North that I have met are of this class, and I am told by an old friend here that in this way, in the last year or so, young and totally incompetent men have been put in responsible positions in this State, and that they have made sad failures, which have brought great discredit upon the whole profession.

It is very evident, as you say, that a man would have to "pay out a good bit" and diet his stomach a great deal before he could locate.

Yours truly, B. K. SMITH, C. E.

SPIRAL CURVES.

RICHMOND, Ind., April 3, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: If it will not tax the patience of your readers too much, I should like to say a few words more on the above subject.

It is now about thirteen years since I took my first lesson on the section, and now have charge of the repairs and improvement of over 400 miles of road; but I never had a firmer belief in the value of easement curves than I have to-day.

About 30 years ago a piece of road about 80 miles long was constructed. The assistant in charge of the field work, now a well-known chief engineer, worked out a formula for an easement curve which he used. About ten years later 50 miles were built on the end of this piece, and only circular curves were used. It has been a fact, acknowledged by all familiar with this track, that the curves on the first piece ride the best. Within the past two years part of both of these pieces have been relaid with new steel and stone ballast put in. When this was done, the lines were all rerun; and, although the curves were very long, and the tangents short, and the spiral slightly different from the original ones on the first piece, the new centers agreed very well with the track, and showed both circles and spiral nearly in their original position, while in many cases of circles alone it was necessary to resort to "heroic treatment" to bring them to shape.

My observation leads me to believe that a curve laid with steel, having good splices resting on a good road-bed and ballast, if kept well tied and constantly to gauge and in good surface, can be kept very nearly to its original alignment during the life of a good steel rail.

Yes, Mr. Editor, I believe that the very little extra work required to lay out spiral curve is well spent, and I believe that the best way to keep good track is to have it put in the best possible shape in the beginning and each time new rail is laid by the best extra foreman obtainable. The section foreman will then, if he has any pride, try to keep it in at least as good condition as when he receives it.

Yours truly, ENG. M. of W.

THE METRIC SYSTEM.

ABBREVIATIONS.

BOSTON, April 3, 1882.

EDITOR ENGINEERING NEWS:

The report of the Metric Committee of the Boston Society of Civil Engineers, dated Feb. 15, 1881, contained, among other valuable matters, an important table of metric abbreviations which, "initiated by the Swiss government, and approved by the government of Italy, has been decided upon by the International Committee of Weights, sitting at Paris." The *Bulletin du Ministre des Travaux Publics* and some other French publications adopt it.

This table of abbreviations is unfortunately incomplete, being limited to those denominations most in use, omitting ten which are by no means obsolete, although less frequently used.

It being important that the entire series should be complete, these ten denominations have been inserted in the table below, with abbreviations recommended by the American Metric Bureau, and in keeping with the others. They are marked with an asterisk to distinguish them from the original series.

The abbreviation *dal.*, adopted by the Paris Committee for the word *dekaliter*, was derived from the French spelling, *deca*. This has always been a source of confusion from its resemblance to *deci*; the *a* being the only distinguishing letter. To avoid this, the spelling *deka* has been adopted by high authority. The committee who reported upon the most proper spelling of the metric nomenclature, said in their report:

"In the prefix *deka* the *k* is used because of the great danger of confusing *deca* and *deci*; besides *deka* is a much better spelling in itself, as there is no danger whatever of mispronunciation; and the *k* is more nearly in harmony with the Greek *kappa*, although that letter is so often represented by *c*. This is in accordance with the government reports of Germany, England and the United States."

The abbreviation *dk.* for *deka* is therefore preferable, and best adapted to the practice of the three countries mentioned above. It is, moreover, more suggestive of the word itself. The abbreviation *dkl.* has been placed accordingly in the table by the side of the form adopted by the Paris Committee.

The table is as follows:

LENGTH.	
*Myriameter	mym
Kilometer	km
*Hektometer	hm
*Dekameter	dkm
Meter	m
Decimeter	dm
Centimeter	cm
Millimeter	mm
Mikron (0.001 mm.)	μ
SURFACE.	
Square kilometer	km^2
Hektar	ha
Ar	a
*Centar	ca
Square meter	m^2
Square decimeter	dm^2
Square centimeter	cm^2
Square millimeter	mm^2
VOLUME.	
*Dekastere	dks
Stere	s
Cubic meter	m^3
*Decistere	ds
Cubic decimeter	dm^3
Cubic centimeter	cm^3
Cubic millimeter	mm^3
CAPACITY.	
*Kiloliter	kl
Hektoliter	hl
Dekaliter	dkl or dal
Liter	l
Deciliter	dl
Centiliter	cl
WEIGHT.	
Ton	t
Metric quintal	q
*Myriagram	myg
Kilogram	kg
*Hektogram	hg
*Dekagram	dkg
Gram	g
Decigram	dg
Centigram	cg
Milligram	mg

A joint committee of the American Metric Bureau and the American Metrological Society recommended a system of abbreviations in the year 1877, which has been extensively used in this country. It differs very little from the above table, except that the measures of volume are omitted, and the measures of surface are less in number.

The system is as follows:

"The initial letter should be used for each word; *m, a, l, g* for the units; *d, c, m* for the divisors; and the capitals *D, H, K* and *M* for the multiples. The kilogram is almost universally called simply the *kilo*, and is abbreviated K."

The slight difference afforded by the use of capitals and small letters has been found to be an insufficient distinction between such similar words as *deka* and *deci*, or *myria* and *milli*, and the forms given in the table are now preferred.

SQUARE AND CUBIC MEASURES.

Surfaces and volumes are usually measured by the squares and cubes of the measures of length.

All the measures of surface, the square myriameter, the square kilometer, etc., down to the square millimeter, being each 100 times greater than the one which comes immediately below it, care should be taken when expressing them in figures to reserve *two* places for each unit of measure.

Thus 1 m^2., 1 dm^2., 1 cm^2., 1 mm^2., is written

1.010101 m^2.

15 m^2., 8 dm^2. is written

15.08 m^2.

37 m^2., 6 dm^2., 62 mm^2. is written

37.060062 m^2.

When reading a number comprising an odd number of decimal places, a zero may be mentally determined at its right hand, thus 6.066 m^2. may be read

6 m^2., 6 dm^2., 60 cm^2.; or

6 m^2., 660 cm^2.

The number 20,202,020,202 mm^2. when divided into its component denominations may be read

2 hm^2., 2 dkm^2., 2 m^2., 2 dm^2., 2 cm^2., 2 mm^2.; or

20,202 m^2., 2 dm^2., 2 cm^2., 2 mm^2.

The same principle applies to the units of land measure.

Thus 7 ha., 7 a., 7 ca. may be written

7.0707 ha.

The ordinary method of expressing areas of land, however, is to state them in terms of hektars and square meters. The above example would ordinarily be written

7 ha. 707 m^2.

The three special denominations of land measure, the *centar*, *ar*, and *hektar*, are in strict accord with these properties of the squares of the linear measures, because they are merely other names for the square meter, the square dekameter, and the square hektometer, respectively. The two intermediate denominations, required by a strict conformity to the nomenclature of the system, the *deciar* and *dekar*, have not been used, because the sides of the squares which they represent, having areas of 10 and 1,000 square meters, respectively, cannot be exactly expressed in terms of the linear measures.

Similarly, the measures of volume, the cubic meter, the cubic decimeter and the cubic centimeter, being each 1,000 times greater than the one which comes immediately below it, care should be taken when expressing them in figures, to reserve *three* places for each unit of measure.

Thus, 1 m^3., 1 dm^3., 1 cm^3., 1 mm^3., is written

1.001001001 m^3.

3 m^3., 82 dm^3., 7 cm^3., 56 mm^3., is written

3.082007056 m^3.

The number 3.1476 m^3. may be read

3 m^3., 147 dm^3., 600 cm^3.,

two zeros being mentally supplied at the right.

These principles, which are merely an application of the laws of decimal numbers, may be illustrated thus,

The number 82.35, if representing *meters*, may be separated into four denominations,

8 dkm., 2 m., 3 dm., 5 cm.,

each composed of a *single* figure.

The same number *squared* gives 6781.5225.

This, if representing *square meters*, may be divided into four denominations,

67 dkm^2., 81 m^2., 52 dm^2., 25 cm^2.,

each composed of *two* figures.

The same number *cubed* gives 558458.377875, which, if representing *cubic meters* and reduced to its component denominations, gives

558 dkm^3., 458 m^3., 377 dm^3., 875 cm^3.,

each composed of *three* figures.

The long decimal fractions resulting from the continued multiplication of numbers, which often lead to a vague and indefinite impression on the mind, assume a very precise and definite character when separated into the squares and cubes of the linear measures; the decimal nature of the metric system rendering this separation possible by simple inspection.

The cubic denominations comprising the *stere* and its derivatives are exceptions to these principles, only one of them, the *stere*, which is another name for the cubic meter, being an exact cube of a linear measure. They progress by a 10-fold ratio, and only require a single place for each denomination. Their use should be restricted to merchandise, which is sold in small quantities by cubic measures.

By the present practice they are used only in the measurement of wood.

CHARLES H. SWAN, C. E.

Chairman Committee on Manufactures, American Metric Bureau.

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S. D. V. BURR. ....ASSOCIATE EDITOR.

SATURDAY, APRIL 8, 1882.

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Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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MISSISSIPPI RIVER FLOODS.

The late tremendous floods on the Mississippi River and the devastation and suffering created thereby have very naturally brought up the inquiry as to the proper means which the general government should exercise to prevent their recurrence, or to mitigate their violence, for it is out of the question to suppose that the respective States through which the river passes can effect anything of practical value to that end. This has naturally brought forward individual schemes and projects, which are urged upon Congress with the persistency peculiar to our American politics, and everyone who has seen water run down hill thinks that he could offer some advice of value to the authorities. The interest at stake has become so vast by the increasing settlement of the Mississippi valley that the plans to be followed for the improvement of its navigation and the protection of the delta from overflow have become subject of bitter controversy. A Mississippi River commission, of which Gen. Q. A. Gilmore is president, composed of three United States engineers of high rank, three civilians of experience in connection with the subject and an officer of the coast survey have been for some time (three years) charged with the operations under the U. S. government on the river, embracing in their duties, of course, the preparation of plans for its permanent improvement. This board have from time to time made reports of progress, and appear before the committee of Congress when called upon, in relation to the subject matter, and their views are strongly antagonized just now, by some prominent individuals supposed to know something of the subject, who are desirous of securing appropriations to carry out their own views, or at all events, to experiment with the government funds in opposition to the projects of the commission.

It is well known that millions of acres of highly productive land are now under the flood-waters of the lower Mississippi, and to the inexperienced eye it would very naturally appear that, if the river had more outlets from the flooded district to the Gulf, to allow sufficient escape to this piled up water, permanent relief from the evils of a flood would be secured. The arguments of the opponents of the River Commission take about the following shape. If we bore two holes in a tub of water it will flow out faster, and its surface will be lowered more rapidly than with one. If we can tap a river with outlets along its course, a greater avenue of escape will be provided for its flood-waters, and they will rise to less height. The Mississippi from Red River, three hundred miles to its mouth, flows along the summit of a ridge, whose sides slope away to the Gulf. These slopes are intersected by bayous. If we open up the head of these bayous to the river, thus furnishing outlets for the surplus waters, we lower the flood heights. This, they say, is the experience of crevasses. The current will be quickened above, the bed scoured out and the waters lowered within the banks. This would seem to be in accordance with common sense and presumed facts in the case, and would be true of the Connecticut, Susquehanna and other rivers, and why not true of the Mississippi? And yet it is not true of this river. The commission of hydraulic experts, men who have no purpose in view but their duty in the premises, and actuated solely by their sense of what is right, and the desire to sustain their professional reputations, most unqualifiedly allege, that "no surer method of ultimately raising the flood surface of the river can be adopted, than by making lateral outlets for the escape of its flood-waters," and sustain this view by experience derived from the action of this river, as well as all other rivers of *like character*. This latter circumstance it is important to bear in mind. The immediate effect of a crevasse during flow, is the reduction of the height of the surface of the river in its vicinity, and below it, and lateral outlets, either natural or artificial, by which the flood waters of the river are drawn off and conveyed through a shorter route to the sea, would tend to prevent the recurrence of destructive floods by supplying additional avenues of escape, but for the fact that the flood-waters of this river are highly charged with sedimentary matters held in suspension by the current alone, and to transport this matter to the Gulf, the velocity of the current must be sustained. The action in the case of a crevasse or of a lateral outlet to the river at flood, is as follows: As a portion of the volume of the river is drawn off by the crevasse when it is first made, it is impossible that the current below the crevasse can be then as rapid as it was before its occurrence. Being less rapid, it is unable to sustain the whole quantity of matter held in suspension by the more rapid current above the outlet, and consequently its surplus sediment falls to the bottom below the crevasse, and a shoal is commenced, which, if the crevasse remains open for any length of time, will continue to extend down stream. This deposition will continue until the size of the river below the crevasse has become so reduced by the shoaling that the current is restored through the short distance in which the bottom of the river has been thus raised and its channel way diminished; but the reduced velocity will still exist in the river below the shoal. As the volume flowing in the river below a crevasse is decreased by the amount drawn off through the outlet, a steeper slope prevails for a distance, because the shoal below the outlet, as it grows in length down stream from the deposition of successive flows, gradually increases the frictional resistance of the volume flowing through that diminished channel, and with an increased head checks the current of the river above and raises its level; and thus the shoaling of the river bed and the raising of the flood line *above* the site of the outlet ensue as a permanent effect. Wherever such stream flows through alluvial deposits, other conditions being the same, the surface slope is least where the volume is greatest, and conversely the surface slope is found to be invariably increased as the volume is diminished. The Mississippi throughout its alluvial basin, not only in its main trunk but in all of its outlets, presents no exception to this peculiar feature, and the U. S. Mississippi River Commission summarize these principles briefly and comprehensively as follows in their report to the Secretary of War:

"If the normal volume of water in a silt-bearing stream flowing in an alluvial bed of its own formation be permanently increased, there will result an increase of velocity and consequently of erosion and silt-bearing power, an increase in area of average cross section, and an ultimate lowering of the surface slope; and conversely, if the normal flow be decreased in volume, there will ensue a decrease of velocity, silt-transporting power, and mean sectional area, and an ultimate raising of the surface slope." So that however paradoxical it may appear, opening outlets for the flood waters of the lower Mississippi to the Gulf will ultimately increase the height of the flood levels.

◆

SANITARY.

We have taken occasion to comment upon sanitary matters from time to time, and we are desirous that the NEWS, while not an organ of sanitary engineering as a specialty, and committed, indeed, in opposition to much that has been advanced as sanitary science, shall yet be fully recognized as advocating all true progress in the direction of reform and improvement in this most important branch of engineering art, and to be fully understood in this connection we make this annunciation—that, in view of the resources of modern art, there is nothing which adds to the real home comforts of life which may not be made perfectly safe and as conducive to health as to comfort. We are induced to touch upon this subject as much misapprehension exists as to the dangers to health of what are called modern improvements in housekeeping, and it is becoming to be considered the right thing to forego some of the luxuries of living, which a few years of use had taught us to consider as necessaries. If foregoing these luxuries consisted in reducing the expenses of living this would be a wholesome return to first principles foreshadowed, but, on the contrary, what every one can enjoy ceases to be regarded as a luxury, and, with the rubbish from our grandmother's garret as ornaments, we must adopt certain of her modes of living, not as we really believe because of their merit in themselves, but with the present craze in this direction it is fashionable to believe so; and the unfashionable masses in great cities in the first place have no grandmothers to inherit from, and, secondly, they couldn't in large cities afford the expense and inconvenience of adopting the comparatively simple and cheap conveniences of their forefathers, these conveniences having become a luxury which none but the well-to-do can afford. We copy from a daily paper the following: "In a carefully prepared essay on the drainage question, by Dr. Hamilton, of New York, he makes these suggestions for the benefit of those who expect to build, and are now troubled by sewer-poison. First, he would have all plumbing having any direct or indirect communication with sewers, excluded from those portions of our houses which we habitually occupy—in other words, placed in a separate building or annex. In the second place, the doctor urges that we return to the open-air fire-place, or the grate, as a means of warming our houses, and, in the third place, he calls for a diminished consumption of oxygen by gas-burners. It is still an open question, whether we shall be able to light our dwellings with electricity, but so long as we are obliged to depend upon gas, we must content ourselves with light, and not illumination. The concessions demanded are named in the order of their importance. The necessity for each is said to be urgent, *but the first admits of no compromise.*"

The director of the New York State Surveys, a member of the State Board of Health, says in his report to the board that he is "convinced that both in England and America, large combined sewers for carrying storm-water and sewage are, *and necessarily must be, constant and powerful sources of disease*," and the Board of Health, adopting his views, condemn them and recommend the separate system of small sewers with flushing-tanks for general use in this State.

Admitting that house plumbing, as usually practiced, is defective, would it not be more sensible and more in accordance with modern requirements to endeavor and perfect the processes now in use, rather than, on the supposition that it is as perfect as can be made, banish the pipes from the living house into an annex, not always to be had at reasonable expense or in crowded localities? If freedom from preventable disease is only to be had by such householders as can afford to have their plumbing separated entirely from their living rooms, under what circumstances are the masses of our citizens to live? Would not a system of piping of better materials and workmanship, and subject under law to periodical inspection, be a simpler method of improvement than the one suggested by Dr. Hamilton? Must we accept as gospel truth what one class of specialists assert as to the permeability of cast-iron pipes to the passage of air (for we are told by Mr. Gardiner that there is no such thing as sewer gas), and the slight impediment which the best water traps interpose to the passage of disease germs, and reject the experience of another class equally entitled to confidence, who deny the possibility of the latter occurrence and challenge any one to the proof? Whoever has any knowledge of ordinary plumbing may rightfully conclude that the practice of the art has not as yet exhausted all the means which are at command for the exclusion of poison from our dwellings.

With regard to the open fire-place, it is undoubtedly a luxury, which all who can afford to avail of should understand the sanitary advantages of, but those whose circumstances forbid its use for house warming, need not suppose that they are thereby given over to irremediable disease and death. There is nothing more certain than that dwellings may be efficiently warmed and ventilated with perfect safety to health by far less expensive methods than by open fire-places.

With reference to the use, or rather misuse, of gas. Such of our readers as have visited the homes of the nobility abroad or their palaces, have noticed the almost universal exclusion of gas and the use, instead, of candles. But this is not on the score of health, but as being more expensive is less plebeian and more elegant, and borders on the ostentatious, as would the use of hickory wood fires for warming a gentleman's house in New York City. If the products of combustion are carried off as they may be by a comparatively inexpensive arrangement, there is no necessity whatever for depriving ourselves of so simple and convenient a method of lighting our dwellings.

That the larger sewers of the combined system "*must* necessarily be constant and powerful sources of disease" we deny. The grounds for the assertion rest upon the supposition that the ordinary flow through them is a "mere trickling thread," whereas the means exist for insuring at the low flow precisely the same form and dimensions of channel as that afforded by the separate system, and were this not the case the 20 or 30 gallons of liquid per capita, which in the older countries is all that they can afford, is usually quadrupled by the more liberal water supply demanded in our cities, and this increased use of water leads Mr. Gardiner to admit that the Memphis main sewers are thereby gorged and back up the sewage in the lower district, the sole remedy for which he states is, "that they be duplicated or rebuilt on a *larger* scale!" The cost and royalty on the patent flushing-tanks, rendered necessary by this system, and the use of which is recommended by the N. Y. Board of Health, even supposing they were a reliable means in all cases, would exceed in a city like New York that of a system of pumping salt water in times of drought into the summits of all the sewers (were the fresh-water supply inadequate in volume), and thus at all times insuring a gravitating current toward the outlets sufficient to prevent any deposit whatever in them.

The tendency of the "traveled" sanitarian is to base his conclusions on the obvious defects of old practices, which are still hampered with antiquated forms and methods of construction, and not under the fostering care of the inventor or his friends, and comparing them with recent works of small range, and which are still in the domain of experiment, his conclusions are necessarily of the nature of hasty generalization; the field of his observations embracing but the obvious defects of the prevailing method in use, and giving undue weight to the anticipated benefits to be derived from the substitution of another. Ill constructed works of sewerage soon become a nuisance, let the principles of their construction be as sound as they may. And as a hydraulic machine to effect a given purpose, any system of sewerage requires periodical inspection, repair and renewal, and to condemn a system as Dr. Hamilton has done, which, theoretically and practically, has been shown capable of great results, *when properly carried out*, because of its presumed danger to life and health when its true principles are neglected, is as absurd as to condemn the use of steam navigation because a neglect of proper precautionary measures may lead to disaster and death. Poisons cannot be eliminated wholly from the economy of nature, but they admit of such ready management through dilution that they may be rendered wholly innocuous. To this end, copious air and water supply, and the machinery through which this is best secured being fully up to the standard now required in all mechanical arrangements of importance, will secure all needed immunity from the dangers which may be supposed to lurk in home comforts.

WATER CONSUMPTION OF CITIES.

From a late report of the Purveyor of the Department City Works, Brooklyn, on an estimated population of 560,000, the consumption of water per capita was 58.44 gallons, distributed under the following items:

	Gals.
Used as determined by meter measurement, per capita	2.31
Estimated on basis of figures used in 1880, per capita:	
Manufacturers and others not metered	5.00
Domestic use	20.00
Private stables	2.00
Street sprinklers and street washers	1.50
Flushing sewers	.50
Drinking hydrants and fountains	5.00
Leaks in mains	2.00
Fire purposes	2.00
Waste	18.13
Total	58.44

The percentage of waste to the total consumption is stated as being 6.86 per cent. less in 1881 than in 1880. It is not stated how this waste is determined nor how the item of leaks in mains was arrived at, but we presume that these were matters of approximation merely.

SPRINGFIELD WATER SUPPLY.

From the Report of the Water Commissioners of the City of Springfield, Mass., we learn that the water in the Ludlow reservoir had become so offensive that many citizens resorted to pumps and such other sources as could be had rather than to use it. Various schemes from outside parties had been advised to overcome the difficulty; among others, that the water should be skimmed and strained; another that the river should be deepened on its shores, and the bottom cleaned from impurities.

The commissioners thought that the cause should be first ascertained before essaying to cure the evil. To this we agree, and when one considers the possible extent of the evil, economy would certainly point in that direction. The reservoir is *seven* miles in circuit, some 450 acres in area, and, according to the commissioners' statement, contains two *billion* gallons.

SEWERAGE OF CITY OF PHILADELPHIA.

The National Board of Health, in a supplement, publish a report of Engineer Wm. H. Baldwin, assistant to Geo. E. Waring, who in the summer of 1881 made a personal examination of the sewerage system of that city. The sewers are described as being built on the plan of forty years since, with dry bottoms, and the connections are frequently made by simply knocking a hole in the sewer, and inserting the branch pipe, piling up brick, earth and stone, and leaving it to take care of itself—poisoning the earth around it, and ultimately resulting either in the sewer caving in, or becoming stopped by the earth above the connection. The entire system, both of construction and maintenance, is not merely faulty, but vicious in the extreme; and were the death rate of the city a high one, there would be no difficulty whatever in sanitarians tracing it to its source. But here comes the anomaly—the death rate, not unfrequently, it is said, falls below 18 to the 1,000, a rate lower than any other large city with which we are acquainted!

Mr. Waring cannot explain this low death rate by attributing it to the large water supply, together with the "combined" system of sewers in use, but ascribes it to the fact, "that the poorer classes are not so crowded together, as in New York and other large cities." If our readers in this connection will please refer to what we have said in another column under the head of "Sanitary," they will appreciate the scope of our remarks wherein we maintain that there is something beyond the mere fact of a sewer being of large size for the reception of storm waters, and built of brick, which influences the spread of disease germs from sewer air; and in truth, how little the system of sewers alone has to do with the death rate in our cities.

PERSONAL.

T. A. Hill is chief engineer of the Austin & Northwestern Railroad, with offices at Austin, Tex.

T. M. Jackson, chief engineer of the Kingwood Railway Company has commenced the work of locating the line. The headquarters of the company are at Kingwood, W. Va.

General George Thom, Colonel of United States Engineers, has been confined to his house at Portland, Me. His physician gave a prescription, and the druggist's clerk, by mistake, put up the wrong medicine, which nearly proved fatal. Antidotes were promptly administered, and he is now quite comfortable.

General De Funiak's duties as General Manager of the Louisville & Nashville, and President of the Pensacola & Atlantic, have forced him to resign his position as Chief Engineer of the Henderson Bridge Company. He will be succeeded by F. W. Vaughan, now Consulting Engineer of the same company.

Honors to an Astronomer.—The Academy of Sciences, Paris, has lately awarded the Valz Astronomical Prize to **Mr. David Gill**, Her Majesty's astronomer at the Cape of Good Hope. Mr. Gill has devoted his time most energetically for many years past to researches on the distance of the sun, and it is in recognition of this service that the award of the Valz Prize has been made to him—especially in consideration of his observations of Mars, at the Island of Ascension, in 1877, as discussed in a recent volume of the Memoirs of the Royal Astronomical Society. The committee was of opinion that the expedition to Ascension was fully successful, as Mr. Gill obtained twenty-two series of observations of the planet, each of which gives a value of the parallax of the sun; and the value resulting from a combination of all these was considered one of the most exact yet obtained. The astronomical prizes offered by the Academy for the present year are the Lalande and the Valz prizes, and a renewal of the Damoiseau prize, 10,000 francs in value, for a review of the theory of the satellites of Jupiter—this subject having been first proposed in 1869, and renewed four times since, no memoir having so far been presented to the Academy which could be regarded as meriting the award.

The University of Michigan.—The total number of students in attendance at the University of Michigan this year is 1,534, just the same as the total given in the annual calendar for 1880-81. Compared with last year, the Department of Law and the School of Pharmacy have made slight gains. In no department has there been any material loss. In point of numbers this university has risen rapidly, till it now holds the leading position among the higher educational institutions of the country. Organized and conducted primarily for the purpose of meeting the wants of citizens of Michigan, it pursues a wise and generous policy toward students coming from other States and countries. At the present time only forty-five per cent. of its students have their homes in Michigan. The number of women in attendance is about one hundred and eighty, or nearly twelve per cent. In the department of literature, science, and the arts, or, it might be called, the collegiate department, students are allowed a wide though not unlimited choice of studies. The aim appears to be to secure the benefits and to avoid the dangers of the elective system by prescribing a part of the work to be done by the candidates for the several literary degrees, or by requiring the student to elect a specified amount of work from limited groups of studies. The announcement of the organization of a School of Political Science, and a description of some of the studies to be pursued in the School, appear for the first time in the calendar for the current year.—*The Nation.*

Pierre Le Play.—A dispatch from London announces the death on the 6th of Pierre Guillaume Frederick Le Play, a distinguished French engineer and writer upon scientific subjects. M. Le Play was born in Honfleur, April 11, 1806. In 1825 he became a student in the Polytechnic Institute. Later on he entered the department of mining engineering, and pursued the different courses until he became a chief engineer of the first class. After finishing his studies M. Le Play contributed a number of papers to various scientific journals, which attracted considerable attention and helped to secure for him a Professorship in the School of Mines, where he was put in charge of the inspection of studies. In 1858 he was appointed a Commissioner-General of the Imperial Commission which had charge of the preparations for the French Industrial Exposition of 1855. He became President of the commission and performed the arduous and important duties of that position so well that he received the title of Counsellor of State in December, 1855. At the London Exposition of 1862 M. Le Play attended as the representative of the French government. Five years later he presided at the opening of the Universal Exposition of 1867. In December of that year he was made a Senator. M. Le Play received many decorations as a member of foreign orders. On the 15th of December, 1855, he became a commander of the Legion of Honor, of which he was made a grand officer in June, 1867. He was the author of a large number of scientific works and memoirs.

Major Charles W. Howell, of the United States Engineer Corps, died in New Orleans, on the 5th, of consumption, at the age of 40 years. He was a native of Indiana, and was appointed from that State to the United States Military Academy at West Point, being graduated seventh in a class of 25 in the Class of '63. On the day of graduation, June 11, he was appointed a First Lieutenant of the Corps of Engineers, and at once entered upon duty in the war of the rebellion, being attached to the Engineer Battalion of the Army of the Potomac. There he remained until May 25, 1865, when he was transferred to the Engineer Battalion stationed at Willett's Point, N. Y., remaining on service there until September of the following year. During his active service with the Army of the Potomac he participated in the Pennsylvania campaign; in the Rapidan campaign, commanding a company of Engineers at that time; in the action of Rappahannock Station, November 1863; the Mine Run operations, Nov. 26 to Dec. 3, 1863; in command of an engineer company in the Richmond campaign from May 4, 1864, to Feb. 16, 1865; engaged in constructing and dismantling bridges, making roads and reconnoissances, sapping and erecting defensive works on the march to the James River, May 4 to June 15, 1864; the action near Cold Harbor, and participating in the siege of Petersburg, from June 17, 1864, to Feb. 17, 1865. While operating before Petersburg he was successively breveted Captain and Major for the gallant and meritorious services during the campaign from the Rapidan to the James, and in front of Petersburg. Subsequently he served in the raid on the Welden Railroad, in the actions and operations about Hatcher's Run in the pursuit of the rebel army, April 3-9, 1865, and at the capitulation of Appomattox Court-house on the latter date. On July 10, 1866, while on duty at Willett's Point, he was made full Captain of Engineers, and in the following September was detailed as Assistant Engineer in the improvement of the Western rivers, other than the Ohio, serving until the following June. From that date until October of the same year he was engaged in surveying a railroad route from Fort Riley to intersect the Union Pacific route at the one hundredth meridian.

He served as Chief Engineer of the Department of Missouri from Dec. 17, 1868, to May 8, 1869, and as Superintending Engineer of the defenses of New Orleans, and of various surveys and improvements of rivers, harbors and canals in Mississippi, Louisiana and Texas since June, 1869. In 1872 he made an examination of the mouth of the river Brazos for the Houston & Great Northern Railroad, the only civil service of importance in which he was engaged. He devised a plan for a ship canal to connect the Mississippi River with the Gulf of Mexico, and himself served on the committee to examine it. The plan was set aside, however, for that of Mr. Eads. The work of improving Galveston Harbor was under his charge, as was also that of devising protection for the New Orleans wharves. Major Howell's body will be taken to his home at Goshen, Ind., for burial.

RECENT INVENTIONS.

A new apparatus for facilitating the lubrication of journals running in boxes, and excluding foreign substances from the oil-duct leading to the journal, consists of the following arrangements of parts, viz.: a chamber for the inclosure of the duct, closing devices constructed in the substance of the journal itself, having communication from its bottom part by an opening with the journal itself, the walls of which chamber constitute a guide for the movement of a plug and spring which operates the same, to close the external port of such chamber. The chamber is provided at its upper part with means for retaining in position over the top of the plug a centrally perforated plate, combined with a plug having a conical head fitted to co-operate with and close the perforation of said plate on its under side actuated by a spring, both spring and plug being confined within said chamber.

A novel air-compressor comprises a cylinder and piston, and a discharge-valve provided with means for balancing it when working under a pressure not materially in excess of that desired, but which will have an access of pressure upon its face and remain open when the desired pressure is exceeded. The discharge-chest and the discharge-valve is subjected to the action of compressed air upon both sides.

A novel means for utilizing secondary batteries on telephone circuits comprises a main line, which includes a secondary battery; an independent branch circuit, which includes the secondary coil of an induction apparatus of a telephone transmitter; a sub-circuit normally held open by the weight of the telephone, which circuit includes the secondary battery and the primary coil of said induction apparatus; switch devices for excluding the secondary battery from the main line and completing the main line through the branch circuit, which includes the secondary coil of the transmitter, and switch devices for completing the sub-circuit when the telephone is removed from its support.

A late improvement in water-closets consists of a bowl forming one leg of a trap, a second trap below the first, an exhaust pipe leading from the air space between the two traps and terminating near the top of the flushing chamber, the latter being provided with inlet and outlet valves, and a flushing pipe leading from the outlet valve thereof to the bowl. Means are provided for preventing further retardation of the flow of flushing water after the bowl has been siphoned by the partial vacuum formed by the descent of water in the flushing chamber, thereby augmenting the after-wash and insuring the final filling of the bowl.

A novel metallic railway tie consists of a flat plate upon which are clamps arranged longitudinally of the tie, with their body portions beneath the same, and provided with a nose projecting above the plate to engage the rail, and with a shoulder to engage a wedge which rests upon the upper surface of the plate. Adjacent to the shoulder is an overhanging lip, which extends over the wedge. The body portion of the clamps have an extended bearing surface, and are provided with elongated ends extending downwardly with laterally projecting flanges. To prevent the displacement of the wedge a fixed lug is provided upon the tie to engage with ratchet-shaped teeth upon the wedge.

A new fire escape ladder is pivoted to the journal of the wheel of the truck for adjusting the angle of the ladder and which has an opening through the same for the ladder to pass sideways. A chamber containing compressed air is secured to the lower part of the apparatus containing a cylinder and piston. The flow of air into the cylinder is controlled by a valve, and assists in elevating the ladder.

The novel elements of an improved drilling machine consist of a supporting frame carrying a fixed drill-shaft, and a circularly movable drill-shaft, and a device for rotating both shafts simultaneously.

A late improved self-acting elevator safety apparatus consists of latches pivoted upon the sides of the elevator shaft or frame, and adapted to engage projections or recesses in the cage, with a spring brought into play by the tension thereon of the main rope under the weight of the elevator suspended therefrom. Intermediate cords are employed by which the spring, when relieved from tension, will be made to act upon the latches, and throw them into effective engagement with the elevator to engage to arrest and support it.

Washington, D. C. F. B. Brock.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 100.

CCLXI.—OAKLAND.

Oakland, California, in lat. 87° 30 N., long. 122° W., on the Bay of San Francisco, is on flat, low, sandy ground. Back of the city are hills rising to a height of 1,500 ft. Settled in 1851, it was incorporated as a city in 1854. Water-works were built by a private company in 1866, after the plans of Anthony Chabot. The supply is taken from San Leandro and Senescal creeks, on which impounding reservoirs are created by earth dams. The San Leandro Lake drains 44 square miles, covers 400 acres, and contains 2,570,057,424 gallons at 200 ft. above the city. The dam is 80 ft. high and 300 ft. long, and 810 ft. wide at the base. The Senescal Lake drains 5 square miles, covers 18 acres, and holds 300,000,000 gallons at 400 ft. above the city.

A 24-in. riveted wrought-iron pipe, coated with asphalte, conveys the water from San Leandro to a distributing reservoir in the city holding 1,000,000 gallons, and two smaller reservoirs on the edge of the city. At the lake outlet the water is passed through screens formed of cotton cloth tacked on frames. Distribution was by wrought-iron, cement-lined pipe until 1878, when some cast-iron pipes were laid. The boiler-iron riveted pipe, coated with asphalte and lined with cement, is preferred; 123 miles of pipe are laid, with 195 fire hydrants, 730 gates and 5,300 taps; 102 meters are in use. The city does not pay for use of fire hydrants.

Service pipes are of galvanized iron.

The population in 1880 was 34,556 and the daily consumption from 5,000,000 to 7,000,000 gallons. The water is used extensively in the dry season for irrigation and for flushing sewers.

The capital stock of the company is $3,000,000. The works have cost to March, 1882, $3,961,644.75, and the gross receipts for water have been $1,356,793.78. There is a bonded debt of $495,000, at 8 per cent. The expenses in 1880 for maintenance and extensions were $167,458.84 and the receipts $202,933.28.

A. Chabot has been the President and Engineer from the beginning, and owns a controlling interest in the stock. Wm. H. Medd is the Secretary.

CCLXII.—TOWN OF LAKE.

The Town of Lake is a suburb of Chicago on level ground on the shore of Lake Michigan. Settled in 1860, it was incorporated as a town in 1867. Water-works were built in 1874 by the town, after the plans and under the superintendence of J. T. Foster.

The supply is taken from Lake Michigan through 1,750 ft. of 30-in. cast-iron pipe, and pumped directly into the mains by Holly quadruplex pumps of 9-in. bore and 21-in. stroke, and a Knowles pump of 20-in. bore and 36-in. stroke. The ordinary pressure is 20 lbs. and the fire pressure 60 lbs. per square inch.

Distribution is by 52 miles of cast-iron pipe of from 16 to 3-in. diameter, with 309 fire hydrants, 360 gates, 3,000 taps and 68 meters. Lead service pipes are used.

The population in 1880 was 15,716, and the daily consumption three million gallons.

The works have cost $1,000,000 and the receipts have been $160,000. The bonded debt is $237,000. The expenses in 1880 were $5,000 and the receipts $30,000. J. T. Foster is the Superintendent.

CCLXIII.—HENDERSON.

Henderson, Kentucky, in lat. 37° 53′ N., long. 87° 37′ W., is on gently undulating ground on the east bank of the Ohio River. Settled in 1797, it was incorporated as a town in 1810 and as a city in 1867.

Water-works were built by the city in 1874–5, after the plans of Thomas J. Whitman, C. E., and under the superintendence of Gaston M. Alves, C. E.

The supply is taken from the Ohio River and pumped by a beam and fly-wheel engine with steam cylinder of 20-in. and two single acting plunger pumps of 14½-in. diameter, all of 60-in. stroke, into a reservoir built in excavation and embankment, lined with 2 ft. of clay puddle covered with 9 in. brick masonry on slopes and concrete on the bottom, 20 ft. deep and holding 3,000,000 gallons at 85 ft. above the business part of the town.

An air-chamber on the pump suction prevents thumping. A wrought-iron stand pipe on the reservoir bank, 5 ft. in diameter and 80 ft. high is designed for use for fire pressure, but is little used.

Distribution is by 7½ miles of cast-iron pipe of from 12 to 3-in. diameter, with 47 fire hydrants, 35 gates and 347 taps. Service pipes are of galvanized iron.

The population in 1880 was 6,573, and the daily consumption 150,000 gallons.

The works have cost $125,000. The bonded debt is $100,000 at 6 per cent. and $13,500 at 5 per cent. interest. The expenses in 1881 were $2,500 and the receipts $5,500. The surplus revenue is devoted this year to pipe extensions. The works are managed by 5 commissioners appointed by the City Council. Fred. Kliederer is the Secretary and Treasurer and Gaston M. Alves the Civil Engineer.

CCLXIV.—VANCOUVER.

Vancouver, Washington Territory, in lat. 45° 31′ 50″ N., long. 122° 27′ 30″ W., on the north bank of the Columbia River. Along the river the ground is level, with a rolling upland back of it. Settled in 1850, it was incorporated as a city in 1868. Water-works were built by a private company in 1868, after plans of August Shaben and Lewis Myers, taking the supply from copious springs and collecting the water in a reservoir holding 500,000 gallons, and formed by constructing a timber dam 7 ft. high and 100 ft. long across a ravine. A wooden pipe of 5½-in. diameter conveys the water 3¾ miles to two brick reservoirs holding respectively 30,000 and 500,000 gallons, built near the city and 90 ft. above it.

Wooden pipe was first used for distribution, but has been replaced by a 4-inch cast-iron main from the reservoir, and wrought-iron of 2-in., 1½-in. and 1-in. diameter in the city. Ten miles are laid, with 6 fire hydrants, 6 cisterns, 10 gates and 175 taps.

The population is 1,700 in the city and 500 in the military post. The consumption is not known.

The works have cost $50,000. The expenses in 1880 were $2,000. No further financial statements are given. J. R. Wintler is the Superintendent.

(TO BE CONTINUED)

Acknowledgements.—The receipt of statistics as follows is acknowledged with thanks: From Wm. G. Richards, superintendent, report of the water-works of Atlanta, Ga., for Dec. 31, 1881. From E. Jacoby, superintendent, statistics and water rates of the water-works of Bloomsburg, Pa. From F. W. Meeker, secretary, report for 1881 of the Newark, N. J., Aqueduct Board. From R. B. Wallace, superintendent, statistics of the water-works of Lafayette, Ind. From S. B. Bowman, superintendent, statistics and water rates of the water-works of Berwick, Pa. From Wm. H. Medd, secretary, statistics and water rates of the water-works of Oakland, Cal. From Samuel L. Brooks, superintendent, statistics and water rates of the water-works of The Dalles, Oregon. From J. R. Wintler, superintendent, statistics and water rates of the water-works of Vancouver, Wash. Ter. From Fred. Kleiderer, secretary, and Gaston M. Alves, C. E., statistics of the water-works of Henderson, Ky. From J. T. Foster, superintendent, statistics of the water-works of the Town of Lake, Ill. From T. A. Ellis, city engineer, 8th report of Water Commissioners and 13th report of Street and Sewer Commissioners of Springfield, Mass.

Corrections.—March 25. *Salem*, Oregon, has 7 miles of pipe, instead of 6.

Pioche, Nevada, has 5½ miles of pipe, instead of 8.

April 1, p. 106. *Chelsea*, 5th line from end, for *Charles River* read *Mystic River*.

Correction.—In your report of Atchison Water-works, the Superintendent failed to mention my name, although the franchise was granted to me by the city, and I engineered the work and contracted with the company to do, and did, all of the work. The specifications only were made by Mr. Whitman. The whole scheme, from beginning to end, was engineered and controlled by me individually, and I assume all responsibility in connection therewith.

S. Watts.

A PRODUCER'S CLASSIFICATION OF IRON AND STEEL.*

The classification of iron and steel proposed by the German Railway Union† as a basis for the supply of railway material having given rise to considerable discussion among the producers of such material, a commission for the purpose of drawing up a revised scheme was formed by the Society of German Ironmasters; and at a general meeting held at Düsseldorf on May 28, 29, 1881, was adopted after discussion. The commission deprecated the practice of using the contraction of the fractured area alone as a principal measure of the toughness of the material, and considered that evidence of greater practical value as to this property is to be obtained from the results of the falling weight and bending tests combined. After some preliminary instruction in the method of preparing test pieces, the classification of the tests is given as follows:

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* *Stahl und Eisen*, vol. i., p. 1; through *Minutes of Proceedings of the Institution of Civil Engineers.*

† See *Minutes of Proceedings Inst. C. E.*, vol. lxv., p. 436.

(I.) TESTS WITH UNDIVIDED OBJECTS.

a. Cold tests. 1, External inspection; 2, hammering; 3, falling weight; 4, direct loading. *b.* Hot tests.

(II.) TESTS WITH SEPARATED PIECES.

a. Cold. 1, Bending; 2, punching; 3, breaking; 4, tensile. *b.* Hot. 1, Bending; 2, punching; 3, forging; 4, welding.

The standards for the different classes of material are:

I. HOMOGENEOUS MATERIAL (STEEL). A. RAILS.

a. Inspection.—As permissable variations in the linear dimensions, ± 3 millimeters in length, ± ½ millimeter in height, and ± 1 millimeter in breadth of flange.

b. Falling Weight.—Tests to be applied to rail pieces that have not been either notched or bored, and whose ends do not project more than ½ meter beyond the bearings. The heights of fall of a weight of 600 kilograms, fixed for rails of different sections, are:

a. Weighing above 30 kilog. per meter and about 130 mm. high, 5 meters.
b. Weighing 27½—30 kilog. per meter and about 120 mm. high, 3.25 meters.
c. Weighing 23—27 kilog. per meter and about 110 mm. high, 2.5 meters.
d. Weighing 20—24 kilog. per meter and about 100 mm high, 2 meters.

The test-piece, 1 meter long, between the points of support in each case to receive two blows without fracture.

c. Loading Test.—For the different sections and weights given above, the weights to be supported without producing more than ½ millimeter permanent deflection, are:

a. 17,500 kilograms; b. 13,500 kilograms; c. 11,500 kilograms; d. 10,000 kilograms.

d. Bending Test.—A length of rail, 1 meter, between the points of support to bend to 50 millimeters over both head and foot without fracture.

B. TESTS WITH PREPARED TEST PIECES.

a. Tensile Test.—Under the assumption that either the contraction of area or the longitudinal extension, but not both, will be used in judging the quality of the material, the commission recommend the following tests:

Bars of 200 millimeters long and 20 millimeters diameter shall bear a minimum load of 50 kilograms per square millimeter, with a contraction of 20 per cent. or an elongation of 12 per cent.

As regards further conditions in contracts for supplying rails, the commission remark as follows:—

1. As limits of toleration in weight, 3 per cent. above and 2 per cent. below the normal amount, and of the excess weight about 2 per cent. should be paid for.

2. As regards maximum length, 9 meters, beyond which very few rolling mills are capable of working, and the risk of damage in transport is greatly increased.

3. About 5 per cent. of the rails shorter than the standard length to be received.

4. The guarantee for rails is fixed at five years, commencing on the 1st of January next following the date of delivery.

5. Rails worn out in regular traffic not to be replaced under the guarantee. The guarantee on rails replaced to terminate at the same date as that on the original contract.

The number of rails reserved for testing not to exceed ½ per cent. of the whole amount.

2. STEEL TIRES.

a. Falling-Weight Test.—To endure three blows of a weight of 600 kilograms, falling 5 meters, without fracture.

Tensile test, with pieces 250 millimeters long and 20 millimeters thick.

1. Locomotive tires. Tensile strength, 55 kilograms; contraction, 25 per cent.; elongation, 12 per cent.

2. Tender and wagon tires. Tensile strength, 45 kilograms; contraction, 35 per cent.; elongation, 18 per cent.

The guarantee of two years not to be extended to tires subjected to the action of brakes, or to those worn out in regular traffic. The toleration in dimensions to be 1 millimeter per meter diameter. The number of tested pieces not to exceed ½ per cent. of the whole.

3. STEEL AXLES.

a. Falling-Weight Test.—To support without fracture upon a length of 1.5 meter between the bearings, six blows from a weight of 600 kilograms, as follows, the point of impact being changed after each blow:

Two of 4 meters drop; two of 4½; one of 5 meters; and one of 6 meters.

b. Tensile Test.—Maximum strength, 45 kilograms per square millimeter; contraction, 28 per cent.; extension, 15 per cent. Guarantee four years against failure through defective material or manufacture. Number of tests not to exceed ½ per cent. of total.

4. STEEL SLEEPERS.

a. Cold Bending Test.—When flattened by moderately heavy blows of a steam hammer to stand bending round a radius of 75 millimeters to a loop without fracture. This test is only to be used when the form of the sleeper permits.

b. Tensile Test.—As for axles, with 30 per cent. contraction, or 15 per cent. elongation.

Permissible variation in weight, 3 per cent. above and 3 per cent. below standard; and in length, for cross sleepers, 15 meters; for longitudinal sleepers the same as for rails. Number of tests not to exceed ½ per cent. of the whole, which is that adopted by the Rhenish Railway. Period of guarantee, two years.

5. STEEL FISH-JOINT AND BEARING PLATES.

The tensile strength to be the same as for rails, but having regard to the great variety in the form of these articles in use the general application of other tests does not seem to be desirable.

C. STEEL CONSTRUCTIVE MATERIAL.

As sufficient experience in the use of steel for constructive purposes is wanting, the Commission does not consider it possible to recommend any special series of tests. In a general way, a tensile strength of 45 to 55 kilograms, with an elongation of 15 to 20 per cent., may be considered sufficient.

D. STEEL PLATES.

1. *Ship Plates.*—The tests recommended are those adopted by the German navy, namely, a tensile strength of 40—50 kilograms per square millimeter. Annealed plates should bend cold upon a radius equal to the thickness through 180° without fracture. Plates 260 millimeters long and 40 millimeters broad, raised to a cherry-red heat, and cooled in water at 28° Cent., to bend round a radius of 1½ thickness without fracture.

2. *Boiler Plates.*—Tensile strength 38—47 kilograms per square millimeter, with an extension of 25—18 per cent. Plates when soft to bend cold through an angle of 180° upon a radius of half the thickness. When hardened to satisfy the test given for ship plates.

The above tests are applicable to plates at least 5 millimeters thick; the testing of thinner ones not being considered necessary.

II. WELDED MATERIAL. A. BAR IRON.

1. Rivet (best best) iron.

For this quality a tensile strength of 38 kilograms per square millimeter, with an extension of 15 per cent., is specified.

a. Cold Bending Test.—Pieces cut from flat bars from 30 to 50 millimeters broad, and not more than 16 millimeters thick, and round bars up to 30 millimeters in diameter, should stand bending into a loop whose inside diameter is equal to the thickness of the bar.

b. Hot Test.—When heated the test piece must bear doubling and a piece of round iron two diameters long must bear reduction to one-third of its length without cracking.

2. Horseshoe nut, or (best) iron.

Tensile strength 36 kilograms, with an extension of 12 per cent.

a. Cold Bending Test.—Flat section, not more than 16 millimeters thick, square and round, up to 30 millimeters diameter, to bend without cracking into a loop whose internal diameter is twice the thickness of the iron.

b. Hot Test.—The test piece of the dimensions previously given must bear bending into a loop whose inner diameter is equal to the thickness of the iron.

The above values for tensile strength and extensibility can only be held to apply to manufactured objects whose thicknesses are not greater than those given under the cold bending tests. If therefore it is desired to test thicker objects, the test pieces must be reduced to the proper size by forging or rolling. The standard length for test pieces is fixed at 200 millimeters.

3. *Ordinary Bar Iron.*—The commission does not consider it possible or necessary to introduce tests for this class of iron, as the differences between the make in the three principal German iron-making districts are dependent upon the local material employed, and cannot be eliminated.

B. RAILWAY MATERIAL.

1, 2, 3. Sleepers, fish-plates and bearing pieces.

The toleration in weight and dimensions to be the same as that given for steel sleepers. Up to the present time railway managers have not specified any particular quality other than fibrous iron generally. Probably a tensile strength of 34 kilograms, and 10 per cent. extensibility, will be sufficient. Should a cold bending test be required, it is proposed that test-pieces 30 to 50 millimeters broad, with rounded edges, should stand bending upon a radius of 18 millimeters as follows:

Thickness,	8—11	millimeters,	50°
"	12—15	"	35°
"	16—20	"	25°
"	21—25	"	15°

Warm tests of these articles are not considered necessary, as they are never subjected to heating in use. As experience shows that the quality of the material is not affected by punching or notching when cold, this should be permitted. The permissible variation in length to be ± 3 millimeters, and in weight ± 3 per cent. It must be remembered that these articles cannot be sawn hot, as is sometimes required, but must be cut cold with a shearing machine.

4. Small iron material. Bolts, spikes, etc.

Usually a high quality of fibrous iron is specified for these objects. A tensile strength of 35 kilograms, with 42 per cent. extension, should be sufficient. The cold and warm bending tests should be the same as for best iron.

C. PLATES.

The commission consider it sufficient to lay down bending and tensile tests for the three best qualities of plates, leaving it to the consumer and producer to distinguish these by particular names. It is to be remarked that many of the names hitherto used are no longer applicable, for instance, so-called charcoal plates are not now made from charcoal iron, etc. A general recognized classification, which should as far as possible express the quality, is much to be desired. The following are the tests recommended:

(I.) WITH ENTIRE OBJECTS.

Inspection.—Each plate, when examined on both sides, is to be free from blisters, cracks, and other marks of defective rolling: surfaces to be smooth and uniform. In dimensions a variation of ± 10 millimeters in length and breadth. The weight to correspond to that form by calculation to within + 5 per cent. in single plates, and ± 3 per cent. in larger quantities.

(II.) WITH PREPARED TEST-PIECES.

a. Bending Tests.—The hot bending test to be round a square edge; the cold ones round a cylinder 26 millimeters in diameter. The angles through which the plate must bend red hot are, for:

	No. III.	No. II.	No. I.
With the fiber, . .	110°	150°	180°
Across " . .	80°	120°	180°

COLD BENDING TESTS.

Thickness.	No. III.		No. II.		No. I.	
	Longitudinal.	Transverse.	Longitudinal.	Transverse.	Longitudinal.	Transverse.
Millimeters.	°	°	°	°	°	°
6— 7	50	30	80	50	110	90
8— 9	45	25	70	40	100	80
10—11	40	20	60	35	90	70
12—13	35	15	50	30	80	60
14—15	30	12	40	25	75	50
16—17	25	10	35	20	70	40
18—19	20	8	30	15	65	35
20—21	15	5	25	10	60	30

The test is to be considered broken when a visible fracture appears in the metallic iron.

b. Tensile Tests.—The cuttings removed from the dome, man hole or fire-tube plates to be used where possible. Fire-box and certain shell plates to be ordered 50 millimeters larger than the dimensions required, to allow the test pieces to be cut from them. The choice of length of the rectangular test piece between 150 to 200 millimeters, and of the section between 300—600 square millimeters, to be left to the maker. The values in the following table, in kilograms, are the breaking strain per square millimeter of the original section. The extension is to be measured after fracture. The numbers given for strength and extensibility may vary by one, but the sum of both must be equal to that of the table.

	No. III.		No. II.		No. I.	
	Longitudinal.	Transverse.	Longitudinal.	Transverse.	Longitudinal.	Transverse.
Tensile strength, kgms	33	30	35	31	36	34
Extension (per cent)	7	5	12	8	18	12

The values given above are those adopted by the German Steam Boiler Inspection Commission at the meeting at Wurzburg, Feb. 10, 1881.

D. CONSTRUCTION IRON.

By this term is meant the quality of rolled bar iron used in the construction of bridges and other large works.

A. TESTS WITH UNDIVIDED OBJECTS.

1. *Inspection.*—The iron must be properly rolled with smooth even surfaces, and free from cracks and cinder patches and other surface defects.

2. *Fracture.*—A flat bar, when nicked with a chisel and bent, must show a mainly fibrous structure, except in the case of bolt or rivet iron, where a fine-grained fracture may be required.

All further tests with full-sized objects are to be avoided, either as being inapplicable or because the information required may more readily be obtained by working upon prepared test pieces. The hot bending test sometimes specified for flat and angle iron bars, of requiring the full sized bar to bend hot through a certain angle, is uncertain, as the result depends mainly upon the skill of the operative making it; a good smith may apply it successfully to an inferior quality of material, while an unskilled one may fail with a better class of iron. The existence of redshortness, which this is intended to detect, may be more readily determined by the hot test upon prepared pieces.

B. TESTS WITH SEPARATED PIECES.

According to its uses, iron for constructive purposes may be divided into the following four classes (I. to IV.) each corresponding to a particular requirement or a particular method of manufacture.

I. For angle and flat bars and plates mainly subjected to strain in one direction.

The plates included in this class are those employed in the tables of girders, tension rods, compression struts, etc.

1. *Cold Bending Test.*—A strip from 30 to 50 millimeters broad must bend, without fracture, round a cylindrical surface of 13 millimeters radius, through an angle varying with the thickness of the plate. These angles are the same as those already given for sleepers and fish-plates. This method of bending is to be preferred to the custom of bending into a loop of large radius more generally practiced, as it may be applied mechanically in a more uniform way than can be done when the result depends in part upon the skill of the operator.

2. *Tensile Test.*—Longitudinal breaking strain, 36 kilograms per square meter: extensibility, 12 per cent.; the test pieces to be from 300 to 500 millimeters long in the extensibilities to be observed upon a length of 200 millimeters.

These figures to apply only to bars whose thickness does not exceed 16 millimeters. Heavier bars should, as a rule, be avoided for such uses. When it is required to test the material of thicker bars, the test must be reduced to the standard dimension by forging or rolling.

3. *Hot Bending Test.*—Strips of the same dimensions as those of the cold bending test, when similarly treated at a cherry-red heat, must bear through the following angles, according to thickness: up to 25 millimeters, 120°; above 25 millimeters, 90°.

2. *Forge Test.*—A strip of a flat or angle bar or plate, cut cold and heated to redness, must extend under the hammer to one and a half time its original breadth, without showing signs of separation in the iron. The radius of the hammer pane to be 15 millimeters.

II. Plates that are subjected to strains in different directions, or mainly to bending strains.

This includes connecting plates, corner pieces, gussets, the web-plates of girders, etc. The cold bending test for these, in the direction of the fiber, is similar to that for the preceding class. Across the fiber the angles are according to thickness—8 to 11 millimeters, 20°; 12 to 15 millimeters, 15°; 16 to 20 millimeters, 10°; 21 to 25 millimeters, 5°.

2. *Tensile Test.*—When the plates are approximately square, the breaking strain is—

Longitudinal, 35 kilograms, with 10 per cent. extension.

Transverse, 30 kilograms, with 4 per cent. extension.

As these plates are mainly used as connecting pieces, the tensile strength may be taken 1 kilogram lower than in group I., as the constructor has to work mainly by the lower strength in the transverse direction. For the same reason the extensibility may be reduced from 12 to 10 per cent. When the length of the plate is much greater than the breadth, the values are:

Longitudinal, 35 kilograms, with 10 per cent. extension.

Transverse, 28 kilograms, with 3 per cent. extension.

These plates are mainly applied in the webs of girders, and of cross and longitudinal bearers, whose length is at least eight times their breadth, for which purposes the transverse tensile strength of 28 kilograms is amply sufficient. The hot bending and forge tests are the same as for group I.

III. Girder iron and flooring plates.

This includes all sections differing from single angle iron, such as I T [¬|_ bars, sash bars, etc.; also buckled, corrugated, checkered and similar plates.

Tensile tests for girders:

Longitudinal, 35 kilograms per square millimeter; extension, 12 per cent.

In this class of iron no great transverse cohesion can be expected as the pressure in rolling in such directions is but small. It is customary to use [iron for connecting pieces, on account of its convenient shape, and in such cases a transverse strength, similar to that specified in group II. should be required. This, however, cannot be obtained under the ordinary conditions of manufacture, and it is therefore preferable in such cases to use a combination of flats and angles rather than a solid section. For covering and flooring plates tensile tests are not necessary, the quality of the material being sufficiently evidenced in the manufacture. On account of their large amount of surface, their substance is more likely to suffer from rust than from loading.

IV. Rivet and bolt iron exposed to shearing strains.

To bend cold under the hammer to a loop equal to the diameter of the bar without cracking on the bend:

Tensile strength, 38 kilograms per square millimeter; extension, 18 per cent. . The limits specified by the different railway authorities vary between 35 and 40 kilograms.

Hot Test.—A piece two diameters long, when heated to the proper working temperature (that of hot riveting) to bear a reduction under the hammer to one-third of its length without cracking at the edges. The commission does not consider it feasible to introduce tests for building girders, for the reasons that have been previously given under the head of common merchant iron.—H. B.

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ASSOCIATION OF CONTRACTORS OF BELGIUM.

In accordance with our promise, we give below a translation of the rules of the Association of Contractors of Belgium.

Work of the Association.—The association has been formed by the various societies and clubs of contractors for public or private works in the country under the name of the "Fédération des Entrepreneurs de Belgique." The object of this association is to watch over the interests of contractors under circumstances in which the action of the various local societies would not be of much avail. It also concerns itself with the advancement of art in contract work, as well as with the perfecting of specifications both as regards their drawing up and the manner in which they shall be interpreted. It likewise takes upon itself the duty of protecting by every means in its power those contractors who may submit their complaints to its consideration, so long as they are well founded, and raise questions affecting the interests of the generality of contractors.

The headquarters of the association are fixed at Brussels.

Members of the Association.—The association is composed of ordinary members and honorary members. Those contractors who live in places where there are no contractors' societies or clubs can become members of the association on payment of an annual subscription of 24 francs (a little less than £1). All contractors belonging to any of the contractors' societies or clubs of Belgium are ordinary members. Contractors in Belgium who no longer carry on their profession, as well as contractors of other countries, can become honorary members.

General Meetings.—The members of the association must attend a general meeting, to be held the first Wednesday in May and the first Wednesday in November. The general meeting shall have unlimited powers, and take all measures that may be deemed necessary to accomplish the objects of the association. It shall fix the subscription, which shall be paid annually by each society or club adhering to the association. Resolutions shall be adopted by a majority of the votes of members present, which shall be ascertained by ballot. All societies or clubs shall have notice of the general meeting eight days previously, the societies or clubs themselves undertaking to give notice thereof to their members. The notice to the chambers or clubs shall contain a copy of the agenda to be laid before the meeting. In case of the absence of the president or vice-president the meeting shall nominate a provisional president, and in the meantime the oldest member present shall act as president.

Formation of a Council.—The association shall be represented by an administrative council. Such council shall consist of (1) a president, vice-president, secretary, assistant-secretary, treasurer, and (2) two delegates from each contractors' society or club in Belgium. The Brussels Society to have the perpetual right of sending three delegates as members of council. The president, secretary and treasurer shall form a quorum, and the council can meet and discuss questions with only these three present.

Nomination of Members of Council.—The association will annually elect members of council at the general meeting held on the first Wednesday in November. The first election is fixed for the first Wednesday in the month of May, 1882. Both candidates for election and electors must have paid all current subscriptions and moneys owing to the society or club to which they belong. If at the first voting no one obtains an absolute majority, the ballot shall begin again, and the election be decided by the relative majority; if two or more members receive an equal number of votes the oldest of them shall be elected. The secretary shall address a letter to each member elected and not present at the meeting, informing him of his election. If the latter should neglect to notify his willingness to serve on the council within eight days from receipt of such letter, his election shall be nullified, and the council shall itself fill the vacancy.

The Rights and Duties of Members of Council.—The president is to summon and preside at each council, and all ordinary and extraordinary meetings. He shall have the sole right of summoning such meetings when he shall think proper, on receiving notice to do so from two members of the council. He shall be compelled to do so at any time on receipt of a demand to that effect signed by at least five members. Should the president refuse to summon a meeting on receipt of such demand, the vice-president shall have authority to do so. If one or more members of council, other than the delegates, shall not be present at the opening of the meetings, the president shall put other members in their places until their arrival. The president shall have supreme authority at all meetings. He shall sign all minutes, etc. All official documents and correspondents shall be addressed to the president and preserved by him. They shall be communicated to the council at the next meeting.

The vice-president shall act as president in the latter's absence; he shall keep himself informed of the progress of matters generally, and shall assist the president in everything.

The secretary shall undertake all correspondence and writing. He shall draw up the proceedings of meetings, resolutions, reports, etc. He shall, as well as the president, sign all resolutions, letters, reports, etc. He shall report each year to the general meeting on the work of the association, and such report shall be preserved in the archives. He shall take copies of all official documents, and such copies shall be deposited in the office for the convenience of members who may wish to consult them.

The treasurer shall have charge of the funds of the association as well as any invested moneys it may be possessed of. Each time that the balance of moneys in hand shall amount to 500 francs he shall inform the council of the fact, and they shall determine the mode of its investment. He shall keep a record of receipts and payments in the order of their date. He shall give receipts for all sums that shall be remitted to him. He shall not pay any moneys away excepting under an order signed by the president and one other member of council. He may, however, pay petty expenses not exceeding 10 francs without this formality on condition that he renders an account thereof to the next meeting of council. He shall twice a year lay before the general meetings a statement of accounts, accompanied by vouchers, etc. He shall keep all invoices, receipts, and such other records of money transactions as may be ordered by the council.

It may be added that M. André Hertogs is the present president of the association, and that we are indebted to him for the original copy of the above rules. We shall not attempt to criticise them here, nor to enter further into the subject at present; we leave them to the consideration of our readers. We may, however, take this opportunity of wishing all success to the Association of Contractors of Belgium and its genial president, M. André Hertogs.—*London Contract Journal.*

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NOTE.—In order to reach the top of a certain plateau in Switzerland, a novel railway is in use. Its rolling stock consists of two cars, which are run up and down the incline road by a peculiar water-power. Each car has a large water-tank. The tank in car No. 1, at the upper end of the road, is filled with water, whose added weight gives the car the power as it runs down the track by gravity to pull car No. 2 from the lower end of the track to the upper, by means of a steel-wire cable, which is attached to each car and passes around a drum at the upper end of the road. When car No. 1 reaches the lower end of the road its tank is emptied, and the tank of No. 2, now at the top, is filled with water, when it in turn pulls car No. 1 to the top. A single track is used, with self-acting switches at the middle of the road, arranged so that the car going up takes one switch while the one going down takes the other, and after the cars have met and passed, each car takes the single track again.

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THE RAILWAY SYSTEM OF FRANCE.—The French Minister of Public Works has published a table showing the length, earnings, expenses, profits, number of passengers and passenger miles, of tons and ton miles and receipts per passenger and per ton per mile of the whole French railroad system for the thirty-eight years from 1841 to 1879 inclusive, beginning with 352 miles and ending with 14,137. On the 8,743 miles of road reporting to the New York State Engineer and Surveyor for the year ending Sept. 30, 1880, there were 30½ per cent. more ton miles than in all France. The average passenger rates of the two countries compare as follows in cents:

	France.	New York.
Per passenger per mile..................	1.612	2.507

The average rate on passengers is 55½ per cent. higher in New York.

AN AUTOMATIC VAULT CLEANER.

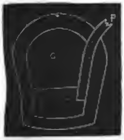
(Translated for ENGINEERING NEWS.)

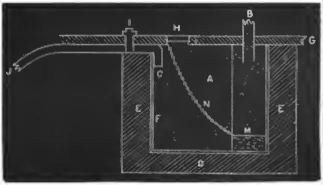
The principles on which M. Mourns bases the action of this machine is that the animal dejecta contain within themselves all the principles of fermentation or of dissolution necessary and sufficient to liquify them, and to render them immediately useful in their return to the soil and without appreciable loss.

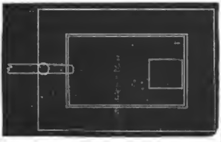
In the figure, *A* is the vault, *B* the soil-pipe from the house, *C* the syphon discharge pipe, *D* concrete foundation, *E* walls, *F* plastering in cement, *G* flagstone curbs, *H* man-hole to the vault, *I* plug for inspection, *J* drain-pipe to the street sewer, *M* box of sand to catch any solids which may accidentally enter through the soil-pipe, *N* chain holding this box and by which it may readily be turned up to the man-hole and cleaned out, *O* street sewer with house-drain, *P* trapped by the sewer water.

The vault may be constructed of any material which can be made water and air tight, of a capacity of one cubic meter to suffice for the service of a house of from 20 to 25 persons. The vault being filled with water, the tightness of the construction and the traps cut off all emanations or escape of gas from the interior into the house.

After the fecal matters enter the vault in sufficient quantities, the liquid becomes turbid and of a brown color but however long continued it may be used, providing that the urine and waste waters enter with it, a fermentation takes place which dissolves all the fecal matters, even the most solid, into particles or filaments so small as scarcely to be discernable, without any deposit adhering to the walls or sides of the pipes.







Nothing is more insoluble in itself than fecal matter, as it is covered by an animal grease or mucus, which prevents the water from acting upon it. Experiments were made by means of a vault with glass sides, like an aquarium, perfectly sealed. There being discharged into this aquarium but fecal matters and a very small percentage of water, yet the liquefaction of the excrements was complete, without any deposition—all remained in suspension. Introduced Aug. 19, the solid dejecta were completely liquefied by Sept. 16, with the exception of the undigested matter, such as seeds and skins of grapes, and some kitchen refuse of vegetable, such as carrots and onion peelings. These floated for a time and then fell to the bottom to await decomposition. Paper disappeared in a like manner. About a liter in bulk of the urine fecal matter and a little water, taken from the aquarium, exhaled but little odor; diluted with 100 times its bulk of water, it was limpid and inodorous. Twenty days in succession there was thrown into the aquarium, with the ordinary fecal matter, about 10 liters of a mixture of urine and soap suds, so as to render the condition as near as may be that of an ordinary cess-pool, and the result was, that the fecal matters always swam upon the surface, forming a sort of scum, never exceeding 5 centimeters in thickness, owing apparently to the constant dissolution going on below. On adding 10 liters of water, the matters not digested, such as vegetables or fruit skins, disposed themselves on the top in the order of their specific gravity, and then, after a time, fell to the bottom to wait their decomposition, which, operated insensibly, but efficiently, the deposit not being sedimentary, but gradually mixing with that above, was discharged with the liquid of the aquarium without any foreign matters appearing in suspension. No pressure from gas is apparent, as was shown by a pipe fixed in the top of the aquarium with a bladder attached, not being distended. On taking off the cover *H*, no bad odor was given out, until the air had time to act, when gas began to rise, and, on closing the opening, the bladder became extended. The operation, to be complete, it would seem the apparatus must be air as well as water tight. The dissolution of matter seemed more active the greater the quantity of water supplied, which admits therefore of the introduction of house and rain water—but they are not indispensable.

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BROOKLYN WATER-WORKS.

Form and date of Proposals to be seen in our advertising columns.

SPECIFICATIONS FOR STEAM PUMPING ENGINE AT RIDGEWOOD ENGINE HOUSE, EAST NEW YORK. ENGINE NO. 4.

FOUNDATION OF ENGINE.—I. The sub-foundation (by which is meant only excavation and preparation of bottom for the reception of masonry to be furnished by the contractor) will be made by the city, the contractor of the accepted design having furnished the requisite dimensions and depth of foundation. Upon this bottom the contractor will erect the requisite masonry foundations for his engine and for the building inclosing the engine. The contractor will be allowed to utilize the present foundations in the engine house, if the design of engine will permit. In case the engine shall be designed to be placed entirely outside of the present engine house, the contractor shall erect a suitable building of the same general character and design as the buildings now erected, or the contractor may enlarge the present engine house so as to receive the new engine, said enlargements to carry out the present character of the building, the design for such building or enlargement to be approved by the commissioner. No plan of engine will be accepted that necessitates any alterations to either of the engines at present in the engine house, or interferes in any way with the running of these engines. The entire work of the foundations and buildings to be subject to the inspection and approval as to design, material and workmanship, of the chief engineer of the Department of City Works.

PLANS OF ENGINE.—II. No plans will be considered which are experimental. The competition between designs will be confined to those of known and approved forms, such as may be seen in operation as pumping engines of reasonable size, and which can point to a record of performance. Nor will a design be accepted simply because certain results are guaranteed, irrespective of considerations of simplicity, durability and liability to accidents, which, duly considered, might, in the opinion of the commissioner, justify their rejection. Beyond this the design is left to the builder. It is the intention that the proposed engine should be connected with the present boiler under their present conditions of working pressure, but should the design of engine not permit of the use of the present boilers, the contractor must include in his bid the expense of independent boilers, boiler house, new chimney and chimney connections, and the boilers properly erected and connected to the engine and to each other.

CAPACITY OF ENGINE.—III. The capacity of the engine to be 15,000,000 gallons delivered into the reservoir in twenty-four hours, and the capacity to be determined by weir measurement at the reservoir. The static head is 161 ft., and the length of 8-ft. main from wall to reservoir 3,400 ft. The new force main of 36-in. diameter will be laid by the city.

STANDARD OF MATERIALS.—IV. All the materials used must be of the very best quality and the workmanship of the very best character. That accuracy of workmanship which is necessary to obtain durability, maximum economy in working, with minimum friction of parts, will be demanded.

DUTY OF ENGINE.—V. The duty of the engine to be 650,000 lbs. ft. per 1 lb. of good quality of anthracite coal fed upon the grates when delivering the guaranteed rate of 15,000,000 gallons in twenty-four hours, and to be the amount of work done divided by the coal used. No deductions for ashes or cinders.

RADIATION.—VI. The cylinders to be covered with such non-conducting material as may be agreed upon, lagged with narrow staves of black walnut secured with brass hoops.

JACKETING.—VII. The steam pipes are also to be thoroughly protected throughout their whole length and lagged in the same manner within the engine room. The steam cylinder to be steam jacketed in the most thorough manner and with provision for delivering the water of condensation from the jacket either into the boilers or through a steam trap.

CONNECTIONS.—VIII. All the steam and water connections with the boilers, and water connections with the well must be made by the contractor. The water connection with the rising main will be done by the Department.

TIME OF COMPLETION.—IX. The bidder must state the time he will require for completing the work and starting the engine in the performance of the above described work, said time of starting not to be later than one year after signing contract, under the forfeiture of the sum of one hundred dollars per day as liquidated damages, for each day after said date that the engine is not completed.

PROPOSALS.—X. The proposals shall be accompanied with such drawings and specifications of dimensions as are necessary for a clear understanding of the proposal, and references to engines of like description at work, as to enable the engineer of the department to judge of the character of the machine. The bidders must state separate prices for engine, or engine boilers and new chimney, if the design calls for the same; for foundations and for new building or enlargement of present building. He must also submit drawings for new building or enlargement of present building, foundations, new chimney, boilers, etc. Two bonds of $50,000 each must accompany each proposition, conditioned that the bidder will enter into contract, if his bid shall be accepted within sixty days after the opening of bids.

TEST OF ENGINE—XI. When in the opinion of the contractor the engine is complete, there shall be a preliminary test of not less than forty-eight hours of its capacity and duty at one and the same time.

CAPACITY—XII. The test for capacity shall be the delivery into the reservoir of 30,000,000 gallons in forty-eight hours, and this capacity shall be determined either by its measure by weir during the whole forty-eight hours or by the determination of the capacity of the pumps for a term of hours, and multiplying the capacity thus determined by the whole number of strokes during the period of test, as the engineers of the department may select.

DUTY.—XIII. In the test for duty the amount of work done shall be estimated by the pounds of water raised into the reservoir, multiplied by the lift, and the lift shall be taken at 171 ft. as established by experiments made upon the other force mains. In determining the amount in pounds of coal fed upon the grates, previous to the test, the boilers will be fired up and the engine run for at least one hour at its usual speed. The engine will then be stopped, fires drawn and rekindled as speedily as possible. Wood used for re-kindling to be charged to the test at two pounds of wood for one of coal, and all coal fed upon the grates to the end of the test to be charged to the engine. No allowance of any sort for cinder, fine coal or slate to be made; the engine to be run as long as the pressure and height of water in the boilers at which they were started are maintained.

PAYMENTS.—XIV. If the engine under this trial complies with the terms of the contract for capacity and duty, the contractor then to be paid up to 90 per cent. of the amount of the contract. But if the engine does not come up to the terms of the contract, one month to be allowed to the contractor for any alterations that he may deem necessary to bring it within the terms of the contract, after which it shall be again tested, and if not then within the terms of the contract, it shall be optional with the commissioner to reject the engine, or to accept it at such a reduction in price as may be determined upon.

PROBATION.—XV. Should the engine go through the test satisfactorily, it then shall be placed on its working trial or probation. This term shall be runs aggregating 5,000 hours and to be completed within the limits of a year. During this term the engineer of the department shall from time to time test the engine as in the preliminary tests, and from the tests thus made, he shall at the conclusion of the term make up the duty of the engine; and if this duty is less than 650,000 lbs. ft. as specified by the contract, the contractor to forfeit $2,000 for every 10,000 lbs. ft. of duty, and any difference of duty below the specified duty shall be upon this basis. The contractor to select the coal, which must be anthracite; but should the coal furnished by the department not be selected by the contractor, the department will furnish at least 20 tons of that selected and have it carefully compared for evaporative capacity with that used by the department, and the contractor will be credited on the comparison, whenever the coal furnished is used. During the probation term of the engine, the contractor to furnish one engineer, to be paid by the department at the same wages as their engineers, who may make such slight repairs as is customary among engineers without any record of the same, but all material and outside work, by whomsoever furnished to be charged to the account of repairs.

Payments.—XVI. Thirty per cent. to be paid on the delivery of two-thirds of the material at the engine-house, properly fitted and prepared for setting up; 30 per cent. when all the material so fitted and prepared is delivered and pump set; 30 per cent. as soon as a successful test has been made; the balance when the requirements of the contract are fulfilled.

Inspection.—XVII. During the construction of the engine, it shall be open at all times to the inspection of the engineer of the department, who may object to any part that seems to him deficient, either in strength or quality of materials, proportion of parts, or workmanship, and in case of a difference of opinion on these points between him and the contractor, the decision of a competent mechanical expert, mutually agreed upon, shall be accepted by both parties, and shall determine the point in controversy.

Engineer.—XVIII. The chief engineer shall have the right, with the consent of the commissioner, to appoint an inspector of the work, and to select an engineer to make the tests, or to associate with himself an engineer to determine upon the merits of the propositions submitted.

Drawings.—XIX. Before the final payment is made, the contractor shall furnish to the department a full set of drawings of the details of engine, foundations, etc., suitable for binding.

Security.—XX. The party to whom this contract is awarded will be required to give satisfactory bonds with sureties, residents of the city of Brooklyn or New York, for the satisfactory and faithful execution of the same, the amount of the bonds to equal the amount of the contract.

Change in Proposition.—XXI. Should any bidder desire to present plans for two or more engines, having collectively a capacity of 30,000,000 gallons in forty-eight hours, such a proposition will be considered. The above specifications shall apply in all particulars to each of such engines, and all conditions above stated shall govern such a bid.

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PREHISTORIC TIDES.

Prof. Ball, of England, in a recent lecture gave the following interesting account of prehistoric tides.

At present the moon is 240,000 miles away, but there was a time when the moon was only one-sixth part of this, or say, 40,000 miles away. That time must have corresponded to some geological epoch. It may have been earlier than the time when Eozoon lived. It is more likely to have been later. I want to point out that when the moon was only 40,000 miles away, we had in it a geological engine of transcendent power. If the present tides be 3 ft., and if the early tides be 216 times their present amount, then it is plain that the ancient tides must have been 648 ft. There can be no doubt that in ancient times tides of this amount, and even tides very much larger, must have occurred. I ask the geologists to take account of these facts, and to consider the effect—a tidal rise and fall of 648 ft. twice every day. Dwell for one moment on the sublime spectacle of a tide 648 ft. high, and see what an agent it would be for the performance of geological work! We are now standing, I suppose, some 500 ft. above the level of the sea. The sea is a good many miles from Birmingham, yet if the rise and fall at the coasts were 648 ft., Birmingham might be as great a sea-port as Liverpool. Three-quarters tide would bring the sea into the streets of Birmingham. At high tide there would be about 150 ft. of blue water over our heads. Every house would be covered, and the tops of a few chimneys would alone indicate the site of the town. In a few hours more the whole of this vast flood would have retreated. Not only would it leave England high and dry, but probably the Straits of Dover would be drained, and perhaps even Ireland would, in a literal sense, become a member of the United Kingdom. A few hours pass, and the whole of England is again inundated, but only again to be abandoned.

These mighty tides are the gift which astronomers have now made to the working machinery of the geologist. They constitute an engine of terrific power to aid in the great work of geology. In the great primeval tides will probably be found the explanation of what has long been a reproach to geology. The early palæozoic rocks form a stupendous mass of ocean-made beds, which, according to Prof. Williamson, are 20 miles thick up to the top of the silurian beds. It has long been a difficulty to conceive how such a gigantic quantity of material could have been ground up and deposited at the bottom of the sea. The geologists said: "The rivers and other agents of the present day will do it if you give them time enough." But, unfortunately, the mathematicians and the natural philosophers would not give them time enough, and they ordered the geologists to "hurry up their phenomena." The mathematicians had other reasons for believing that the earth could not have been so old as the geologists demanded. Now, however, the mathematicians have discovered the new and stupendous tidal grinding engine. With this powerful aid the geologists can get through this work in a reasonable period of time, and the geologists and the mathematicians may be reconciled.

* * *

RECENT INVENTIONS.

DRIVING PILES BY ELECTRICITY.

The successful application of electricity in new fields of labor continues to be recorded. At Hatfield Park, the seat of the Marquis of Salisbury, the piles to support a coffer-dam across the River Lea have just been successfully driven by the power of a water-wheel situated at a distance, which power was transmitted by two dynamo machines to the gearing connected with the pile-driver of ordinary construction erected on a barge floating in the river. The machinery worked well, lifting a monkey weighing about 400 lbs. with ease and regularity. It is not stated how far the power was transmitted. By a French experiment M. Deprez has succeeded in obtaining successful work after the current had passed through 49 miles of ordinary telegraph wire.

DUMPING CARS BY COMPRESSED AIR.

The platform of the car is made in two longitudinal sections, which are hinged each to its respective side of the car-frame. Air cylinders are attached beneath transverse timbers of the car-frame, and are provided with pistons having oval heads working upward through openings in said transverse timbers. An air pipe connects the air cylinders, and is attached to any suitable compressed air apparatus. Stop-cocks are provided which regulate the flow of compressed air into the cylinders, the pistons of which, responding to the pressure, permit the oval heads to raise the platform sections, and discharge their loads to the right and left.

DRAW BRIDGE.

The span is made in two sections or trusses, each truss of which spanning an opening, and hinged at its inner end to the turn-table. Flexible connections at the inner ends of the upper chords are deflected at their middle part from a right line, thereby causing such upper chords to approach each other, so as to tilt the outer ends of the bridge. Such deflection is effected by a right-and-left-hand screw.

NOVEL FAUCET.

This improvement consists of a disk located in the faucet casing. A valve is carried by the disk so connected therewith that the passage of liquid from the under to the upper side of the disk is effectually precluded. A screw-lever is employed for adjusting said disk to shift the valve into or out of contact with its seat, and has a swiveling connection with said disk. The ordinary removable cup or plug is provided, in which the screw works, and an elastic or flexible sleeve of packing material is employed, loosely surrounding said screw and fitting outside the adjacent edges of said disk and said cap or plug, whereby leakage through said cap or plug is effectually prevented.

INTERLOCKING SWITCH-LEVER.

The switch stand is provided with a sliding plate having a diagonal lever-slot and a straight notched lever-slot supported upon transverse ribs on a fixed plate having parallel lever-slots, whereby the switch and signal-operating levers are interlocked.

ELECTRIC LAMP.

A late improvement in electric lamps comprises the novel arrangement of the following elements: In circuit with the carbons is a main magnet which tilts a lever carrying a train of gears, and thereby establishes the electric arc. A second magnet in the same circuit holds the train normally locked. A shunt around the second magnet is automatically closed and opened by a magnet in a high resistance branch around the arc, whereby said second magnet releases and locks the train of gears which regulate the arc.

RAILWAY CROSSING.

A novel crossing-plate has lugs and recesses for the reception and attachment of the rails, which abut against an intermediate block and are secured by ratcheted wedges and pins.

RAILWAY CAR-SPRINGS.

This improved car-spring consists of two or more volute spiral members, each of uniform thickness throughout its length, and having an edgewise taper from one end to the other. The said members are of different lengths, and concentrically coiled and unconnected with each other. This construction is adopted in order to obviate the difficulties which are experienced in spiral springs, in which the bar is uniform in cross-section throughout its length, and which do not settle uniformly when subjected to pressure.

NOVEL BORING-BAR.

The following are the essential features of late improvements in boring-bars: The bar or shaft has a transversely-slotted head and a segmental female screw-thread formed on one side of its slot or opening. A block or tool-holder is adapted to receive a shouldering or facing tool, and fits in a recess in the head of the bar. A feed-screw is fitted in a recess in the tool-holder and engages the female thread of the boring-bar. A stock is provided, fitting the socket in the feed-screw and serving to impart rotation thereto.

Washington, D. C. F. B. Brock.

CORRESPONDENCE.

METER RATES.

Editor Engineering News:

I have for a long time thought that a reduction in the price of water furnished large consumers should be made, but not in the usual way—by placing an arbitrary rate per 100 cubic feet or 1,000 gals., thus:

10,000 gals. or less, per 1,000 gals.	$ .60
10,000 to 20,000 gals., per 1,000 gals.	.50
20,000 to 30,000 " "	.40

As by this method there are points at which the consumer by *wasting* could actually save money, thus:

19,000 gals. @ 50c	$9.50
21,000 " @ 40c	8.40
2,000 " waste	$1.10

saved by consumer.

I give the above figures only from recollection, and the actual prices may not be correct; but the fact is.

The question, which is not a very deep one, is how to rectify this so as to give large consumers a reduction and at the same time not allow them to waste in order to save money.

If we assume the quantity of water used = Q, and if in cubic feet we use as the unit 100, or, if in gallons, 1,000, and X = the ratio; if the decrease of the cost be some power of $Q \pm n$,

$$\text{Then we shall have } X = \frac{Q^n}{100}$$

TABLES OF METER RATES.

$$\text{Ratio} = \frac{Q}{100}^{.9}, \text{ in which } Q = \text{cubic feet.}$$

Cubic Feet.	0	100	200	300	400	500	600	700	800	900
0	0.	1.0	1.9	2.7	3.5	4.3	5.0	5.7	6.5	7.2
1,000	7.9	8.6	9.4	10.1	10.7	11.4	12.1	12.8	13.5	14.1
2,000	14.8	15.5	16.2	16.8	17.5	18.1	18.8	19.4	20.1	20.7
3,000	21.4	22.0	22.6	23.3	23.9	24.5	25.2	25.8	26.4	27.0
4,000	27.7	28.3	28.9	29.5	30.2	30.8	31.4	32.0	32.6	33.2
5,000	33.8	34.4	35.0	35.6	36.2	36.8	37.4	38.0	38.6	39.2
6,000	39.8	40.4	41.0	41.6	42.2	42.8	43.4	44.0	44.6	45.2
7,000	45.8	46.4	47.0	47.6	48.1	48.7	49.3	49.9	50.4	51.0
8,000	51.6	52.2	52.8	53.4	53.9	54.5	55.1	55.7	56.2	56.8
9,000	57.4	58.0	58.5	59.1	59.7	60.2	60.8	61.4	62.0	62.5

Cubic Feet	0	1,000	2,000	3,000	4,000
10,000	63.1	68.6	74.1	79.6	85.4
20,000	117.7	123.0	128.3	133.5	138.7
30,000	169.6	174.7	179.7	184.7	189.8
40,000	219.7	224.6	229.6	234.5	239.4
50,000	268.6	273.4	278.2	283.0	287.8
60,000	316.5	321.2	325.9	330.6	335.4
70,000	363.6	368.2	372.9	377.6	382.3
80,000	410.0	414.6	419.2	423.8	428.4
90,000	455.9	460.4	465.0	469.5	474.0
100,000	501.2	505.7	510.2	514.7	519.2
110,000	546.1	550.5	555.0	559.5	563.9
120,000	590.5	595.0	599.4	603.8	608.2
130,000	634.7				

Cubic Feet.	5,000	6,000	7,000	8,000	9,000
10,000	90.9	96.3	101.7	107.1	112.5
20,000	143.9	149.1	154.3	159.3	164.5
30,000	194.8	199.8	204.8	209.8	214.8
40,000	241.7	249.1	253.0	258.9	263.7
50,000	292.6	297.4	302.2	307.0	311.7
60,000	340.1	344.8	349.5	354.2	358.9
70,000	386.9	391.5	396.1	400.7	405.4
80,000	433.0	437.6	442.1	446.7	451.3
90,000	478.6	483.1	487.6	492.1	496.7
100,000	523.7	528.2	532.6	537.1	541.6
110,000	568.4	572.8	577.2	581.7	586.1
120,000	612.6	617.1	621.5	625.9	630.3

In the tables you have I have assumed $n = 0.9$, and then $X = \frac{Q^{0.9}}{100}$ = the ratio of cost.

Now, to make the rates correct, the parties in power should fix some rate for 100 cubic feet, and the whole formula would be $\frac{Q^{0.9}}{100} R = c$ = cost for Q feet.

Take, for example, 100 cubic feet = unit used. Then for 100 cubic feet $X = 1$, and for 1,000 cubic feet $X = 8.6$ instead of 10, and for 2,000 $X = 15.5$ instead of 20, and if $R = 40$ cents

for 100 cubic feet c = .40
" 1,000 cubic feet c = 3.44
" 2,000 cubic feet c = 6.20, etc.

Engineer.

THE METRIC MEASUREMENT OF LUMBER AND FIRE-WOOD.

Boston, April 6, 1882.

Editor Engineering News:

The following explanation of the metric method of measuring wood, part of which originally appeared in the "Bulletin of the American Metric Bureau," for June, 1879, will be an appropriate conclusion to this series of articles upon the practical implements and methods of the metric system.

THE MEASUREMENT OF LUMBER.

"Lumber measure has been a stumbling-block to many students of the metric system. Nothing was said on the subject by any of the books, and no one seemed to know how to measure lumber metrically. The Bureau appointed Prof. William Watson, late of the Mass. Institute of Technology, and C. H. Swan, C. E., of the City Engineer's Office, Providence, to investigate this matter thoroughly, and report the best method. The plan submitted will commend itself to every reader.

REPORT OF THE COMMITTEE.

"The committee to whom was referred the metric measurement of lumber have attended to their duty to the best of their ability, and respectfully present the following report:

"The present system of board measures expressed in metric units would be an anomaly, and the committee do not see any reason for departing from the system of lumber measurement adopted by all countries using the metric system.

"The unit of measurement is the cubic meter or stere, to which the price is annexed. The cubic meter or stere being divided into 1,000 cubic decimeters or millisteres, a cubic decimeter or millistere is the smallest quantity usually considered (the cubic decimeter being about four-ninths of a foot, board measure, which contains 144 cubic inches, or one-twelfth of a cubic foot).

"The dimensions of the piece of lumber being taken in centimeters and multiplied together, by pointing off six figures from the right we obtain the contents in cubic meters or steres. For ordinary lumber, the last three decimals are unnecessary and may be omitted.

"Surveyors of lumber would mark each board with an Arabic numeral denoting its cubic contents in cubic decimeters or millisteres.

"For the purpose of measurement and rapid computation, the committee have prepared a scale to be used by lumber surveyors, the drawing and description of which are hereto annexed."

PRACTICAL APPLICATIONS.

Lumber of all kinds may be measured by the following simple

Rule.—Measure in *centimeters* the length, breadth and thickness, and multiply the three dimensions together.

If the measurement is to be given in *cubic decimeters or millisteres*, as would be the case with small pieces of lumber, point off *three* figures from the right. The figures at the left of this point will give the number of *cubic decimeters or millisteres*. For ordinary lumber the figures at the right of the point are unnecessary and may be omitted.

If the measurement is to be given in *cubic meters or steres*, point off *six* figures from the right. The figures at the left of this point will give the number of *cubic meters or steres*; those at the right of the point will give decimals of the cubic meter or stere.

The dimensions of merchantable lumber were undoubtedly determined, in the first instance, by the conditions governing the strength and stability of buildings; the most convenient dimensions in *inches* meeting these conditions, being those adopted in practice.

One of the results following the complete adoption of the metric system will be that the most convenient dimensions in *centimeters*, meeting the same conditions of strength and stability, which are independent of the system of measurement employed, will then be adopted for the sizes of lumber. This will necessarily simplify the work of metric measurement. The variations found in lumber of any nominal size are, in many instances, greater than the differences between such metric dimensions and those now in use.

Much time may be saved by using either of the following modifications of the above rule when measuring lumber of *regular* form.

Pieces of regular *breadth and thickness*, but of varying lengths, such as timbers and joists, can be quickly measured by means of a table giving the cubic measurements of different lengths of each size of merchantable lumber. Knowing the length of a piece, its cubic measurement can be taken directly from the table. A more compact but less convenient table could be made, giving the cubic measurement of *one meter* in length of each size of lumber. Such a table would require one multiplication for each measurement.

Pieces of regular *thickness*, but of varying breadth and length, such as boards and planks, can be easily measured by means of a *metric square-measure rule*, similar in character to those now used by surveyors of lumber.

This rule gives the area of boards, etc., varying in length from 3 meters to seven meters, and in width up to one meter, in *tenths of a square meter*. The area given by the rule, when multiplied by the thickness in *centimeters*, gives the cubic measurement in *cubic decimeters or millisteres*. This rule is used precisely as the ordinary board-measure rules are use.

The length of the board being measured in meters, the rule is laid across the board with its brass shoulder against the left-hand edge. At the point where the right-hand edge of the board crosses it, the area is read upon the line of divisions corresponding to the length of the board.

A small reference table containing the ordinary multiples of the numbers on the rule, could be conveniently used to avoid computing each amount. Such a table would comprise the numbers from 1 to 70, with their multiples corresponding to the thicknesses, in centimeters, commonly used for the various kinds of lumber.

The *metric square measure* rule is not simply a board-measure, but it is a metric rule for mechanical quadrature, and has many applications outside the lumber business.

A *cubic measure* rule specially adapted to the measurement of lumber of some specific thickness, giving the volume directly in cubic decimeters or millisteres, and avoiding all multiplication, could be made and would be simple in character. It would, however, avoid multiplication only in the particular case to which it is adapted.

When metric dimensions shall have been adopted for lumber, boards 2.5 centimeters thick will constitute the largest part of the lumber commonly used.

The measurement of lumber will then be much facilitated by the use of a special cubic measure rule, adapted to a thickness of 2.5 centimeters. It may be used to measure lumber of other thicknesses by multiplying its results by a suitable factor obtained by the formula

$$0.4t,$$

in which t is the thickness in centimeters.

A small reference table comprising the numbers from 1 to 175 with their multiples corresponding to the thicknesses used, could be conveniently employed to avoid computing each amount.

The square measure rule is more simple in principle, and its factors are usually more convenient than those required for the cubic measure rule. On the other hand, the latter will avoid multiplication entirely in the majority of cases.

A consideration of the method of marking the measurement upon the lumber does not strictly belong to a discussion of the application of metric methods. Some modification of the present practice, which is adapted to another system, will doubtless be necessary.

A marking in Arabic numerals would require the least number of characters, and being distinct from the present method, would always indicate the kind of unit employed in the measurement of each individual piece.

The metric unit for measuring small pieces of lumber, the *cubic decimeter or millistere*, may be easily kept in mind, it being *one-tenth of a square meter, one centimeter thick*.

THE MEASUREMENT OF FIRE-WOOD.

The metric measurement of fire-wood is extremely simple. The wood being neatly and compactly piled, the three dimensions of the pile are measured in *meters and decimals* and multiplied together. The product is the volume of the pile in *cubic meters or steres*. The decimals to the right of the first or second place are unnecessary and may be omitted.

Besides measuring the total volume of a pile by the above method, the wood merchant has frequent occasion to measure specific volumes of wood. For this purpose a *measuring-frame* is used.

A measuring-frame consists of two stout uprights, strongly framed into a horizontal sill, which extends beyond them on either hand, and receives the lower ends of two inclined braces, which are framed into the uprights and sill. The dimensions of a frame are determined by the principle that the volume measured by it is the product of the length to which the logs are cut, multiplied by the distance between the uprights and multiplied by their height. The length of the logs and the distance between the uprights being determined, their height is obtained by a simple calculation.

Metric measuring-frames are four in number. Their dimensions are given in the following table:

Name of the Measure.	Its capacity in steres.	Distance between uprights.	Height of the Uprights.	
			For wood 1.22 meters (4 ft.) long.	For wood 1 meter long.
		Meters.	Meters.	Meters.
Half-dekastere	5.0	3.0	1.366	1.667
Double-stere	2.0	2.0	0.820	1.000
Stere	1.0	1.0	0.820	1.000
Half stere	0.5	0.5	0.820	1.000

The uprights of the *stere* and *half-stere* frames being divided into *ten* and *five* equal parts, respectively, each division is equivalent to one *decistere* of volume.

It is not necessary to consider the *centisteres* in the measurement of fire-wood.

In the forest it is convenient to arrange wood in piles of one or two *dekasteres* each.

THE MEASURES OF SOLIDITY.

The metric system provides two classes of measures of volume, or solidity.

The first, and more general class, consists of the cubes of the linear measures. The several denominations of this series increase by thousands, and each requires three places in which to write its units.

The second and more special class consists of the *stere* and its derivatives. The several denominations of this series increase by tens and require but one place.

Authorities agree in limiting the use of the *stere* to the measurement of *wood*. The best authorities restrict it to the measurement of fire-wood, and use no denomination smaller than the *decistere*. A few permit its use in the measurement of *round and square timber*, and recognize the *centistere*.

Should the *stere* and its derivative denominations be used in the measurement of *lumber and boards*, the *millistere*, equivalent to the cubic decimeter, will be necessary.

The complete table of measures of solidity would then be as follows:

Millistere	ms. =	1 cubic decimeter.
Centistere	cs. =	10 cubic decimeters.
Decistere	ds. =	100 cubic decimeters.
Stere	s. =	1 cubic meter.
Dekastere	dks. =	10 cubic meters

CONVERSION TABLES.

One foot, board-measure = 2.3596 millisteres.
One millistere = 0.4238 ft. B. M.

One cubic ft. = 2.8315 centisteres.
One centistere = 0.35317 cubic ft.

One cord ft. = 4.5304 decisteres.
One decistere = 0.22073 cord ft.

One cubic yd. = 0.76451 cubic meters.
One cubic meter = 1.30802 cubic yd.

One round ton = 1.1326 steres.
One stere = 0.88291 round ton.

One hewn ton = 1.4158 steres.
One stere = 0.70633 hewn ton.

One cord = 3.6244 steres.
One stere = 0.27591 cord.

Charles H. Swan, C. E.,
Chairman Committee on Manufactures American Metric Bureau.

* * *

New York, Chicago & St. Louis.—Track is now laid from Hammond, Ind., east to beyond Vermillion, O., 285.27 miles, the gap between Hammond and Ft. Wayne having been closed. Track is also laid east of Erie, Pa., to a point 101.02 miles from Cleveland; east from Brocton, N. Y., 9.50 miles, and west from Hammond, Ind., 0.50 mile. This makes 396.29 miles laid in all, an increase of 21.25 miles since our last statement. These 21¼ miles were laid in nine working days, being over 2 miles a day. The same rate of progress is now kept up, and it is expected that by April 15 over 400 miles of the track will be down, leaving about 120 miles to be laid.

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.

Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR. ....ASSOCIATE EDITOR.

SATURDAY, APRIL 15, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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A BUILDING MATERIAL EXCHANGE has been organized in this city, mostly by former members of the Mechanics' and Traders' Exchange. Rooms have been taken at No. 12 Dey street, and the Exchange will begin business about May 1.

SANITARY.—We call attention to some experiments in the removal of house sewage in another column, under the head of "An Automatic Vault Cleaner." The experiments have been conducted, we are told, with marked success for several years. If the repetition of these experiments here should tend to verify the results attained abroad, it would go a long way to solve the question of the proper method of providing for house drainage without the threatened dangers attending the introduction of sewer gas.

THE METRIC SYSTEM.—The series of papers by Mr. C. H. Swan, on the metric system, of which the concluding one is published this week, are unlike the ordinary writings about the metric system, which treat mostly of the derivation and nomenclature, or are mere controversial effusions. These, on the contrary, treat of its implements and practical applications, and speak of it as a perfected system, ready for immediate use. We do not know of any papers now published in this country, or perhaps in the English language, that are so complete as they are, yet they are based upon the official school books of the French *primary* and *secondary* schools. Our school books are beginning to show the system, though very incompletely.

PERMANENT ROADWAYS.—George D. Ansley, Mem. A. S. C. E., City Surveyor of Montreal, Can., has just submitted a very valuable report on "Permanent Roadway Pavements" for that city, to the Road Committee. The report has been printed and forms a neat octavo pamphlet of 18 pages, in which is embodied much that is valuable to every city engineer. Mr. Ansley, after specifying the desirable features of a good pavement, describes the various kinds of pavements, as asphalt, which he classes as "front rank," compressed asphaltic blocks, Pelletier, mastic, wooden block, cobblestone, block stone, macadam, and he closes with his recommendations for Montreal, with a few notes on repairs and maintenance and some "general remarks." To parties interested in pavements this pamphlet is of value. It can probably be had by addressing Mr. Ansley, City Surveyor's Office, Montreal.

BRIDGMAN'S NEW MAP.—There are so many features to commend this map that we refer our readers to the prospectus which we publish elsewhere, and which will fully explain itself. It is on a scale of five miles to the inch. The lettering is bold and distinct. In the free spaces are given the whole of Long Island, at scale, a ward map of New York City, a map of the United States, and various tables of statistics—population, Congressional districts, railroad distances, post-offices, express companies, etc. As railroads in process of building (like the West Side and the New York, Lackawanna & Western) are represented as complete, the map in this respect will be less out of date a year or two hence than now.

A NATIONAL MINING and Industrial Exposition is to be held at Denver, Colorado, commencing August 1 and continuing to September 30. The President is ex-Governor H. A. W. Tabor, and H. D. Perky is General Manager. The Exposition Co. have published a circular pamphlet in which the programme, etc., is fully given. The object of the exposition is "To bring capital face to face with these opportunities for investment, and with skilled labor; to more rapidly develop the country, is an aim and purpose of the Exposition, and the display now in preparation is designed especially to hasten the establishment of extensive and flourishing industrial communities."

Any information required by firms or individuals desiring to participate in the Exposition will be promptly furnished by S. T. Armstrong, Secretary, Denver, Colo.

◆

TESTS OF STRUCTURAL MATERIALS.

A synopsis of the proceedings of the Institute of Mining Engineers was published in No. 8 of ENGINEERING NEWS, Feb. 25, and the valuable papers read on the occasion were given by their titles. The published proceedings now before us are too voluminous for our pages, but a subject of great interest to engineers—the testing of materials of construction—was prominently brought forward and treated very ably from the different standpoints of individual members of the convention, and the purpose aimed at in these papers would be well conserved by spreading them before our readers, were it possible to do so. For the benefit of such of our readers as having decided views on the subject, may aid in furthering the pending legislation, which is alone needed to insure a practical result of great and growing interest to the public at large, as well as constructing engineers, we would state that Gen. J. M. Campbell, the Chairman of the House Committee on Manufactures, has expressed his more than willingness to receive the views of individuals, either in writing or personally before the Committee, in reference to the bill which he has introduced, and we trust that the profession generally will be found ready to respond to his wishes. The following is the text of the House bill referred to, and numbered H. R. 4,726, read twice and referred to this Committee.

A BILL authorizing the President to appoint a commission of experts, skilled in the investigation, production and use of metallic substances and other structural materials, to execute tests and experiments on iron, steel and other materials used in the construction of bridges, buildings and mechanical structures, and deduce useful rules therefrom.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

SEC. 1. That the President of the United States be and he is hereby authorized to appoint a commission of seven members selected from among men skilled in the investigation, production and use of metallic substances and other structural materials, to hold their appointment during the pleasure of the President of the United States; which commission shall plan and superintend the execution of such tests and investigations of materials used extensively in the construction of buildings, bridges, ships and other structures and machinery, as it shall think most important to be made, and from time to time publish results of the tests and investigations, and also such scientific principles and such practical rules deduced therefrom as it shall consider most useful. The said commission shall organize itself, and adopt such rules, and make such assignment of duties among its members as it shall deem most promotive of the object of its appointment. Vacancies occurring from time to time in said commission shall be filled by the President of the United States.

SEC. 2. That the said commission shall report its work, with its results and the deductions made therefrom, annually to the Secretary of the Interior, and its accounts shall be settled in the Interior Department, through such channels as the Secretary shall direct.

SEC. 3. That the members of said commission shall be entitled to mileage and other necessary expenses incurred in the prosecution of their duties, but no salaries as members of the commission.

SEC. 4. That the said commission is hereby authorized to appoint a principal expert, who shall personally conduct the examinations and tests which the commission shall direct, with such assistants and laborers as may be necessary, and also to purchase such material for test and investigation as may from time to time be required.

SEC. 5. That this act shall take effect immediately.

We believe that the initiative in this direction was taken at a convention of the American Society of Civil Engineers, held in Chicago in June, 1872, on motion of Gen. W. Sooy Smith, to appoint a committee of that Society to memorialize Congress on the subject, and which resulted in the passage of a law in March, 1875, for the appointment of a "United States Board to test Iron and Steel," with an appropriation of $75,000 to carry out the object of the bill. The first duty of the Board was of course to perfect a machine on such a scale as to grapple with the full dimensions of the material then in use, and at the same time of such delicacy of construction as to reduce the errors of the machine itself to an insignificant fraction. There was no precedent for such a machine, and in consequence the cost of erecting one could not be foreseen. Fortunately there was no question of the kind of machine to be built, and to Mr. A. H. Emery's genius we are indebted for the result in a machine which is pronounced by all who are entitled to an opinion on the subject as a marvel of mechanical genius and skill—unapproachable by anything in existence of the same purport.

The appropriation was thus exhausted, and an effort was made in 1876 to secure further appropriations to carry on the work, under what embarrassments may be judged of by the remark of the Chairman of the Appropriation Committee of the House to an engineer seeking information: "Can you tell me how many Democrats there are on that Board?" The final result was a small appropriation and legislating the Board out of existence; the testing machine being remanded to the custody of the Ordnance Department, U. S. Arsenal, Watertown, but accessible for private use under a system of fees.

At the convention of the Institute of Mining Engineers in February last, the discussion on this subject of reappointing a U. S. Commission to test materials was briefly opened by Mr. Ashbel Welch, President of the A. S. C. E., and followed by Mr. Charles Macdonald, of the same society. Upon reading the latter paper, we concluded that the whole ground had been covered, and nothing further remained to be said; but so far from this proving the fact, every member of the Institute who spoke upon the subject brought either new light, or, seen from a different standpoint, presented such additional and cogent reasons for the necessity of such Government commission, that it is difficult, in justice to the speakers, to quote from them briefly in the limited space at our command; and without disparaging the value of the remarks of Gen. Meigs, Capt. Lyle, E. D. Leavitt, Jr., T. C. Clarke, O. Chanute, Dr. Egleston, G. S. Morison, Percival Roberts, Jr., and Wm. Metcalf, all of whom contributed of their experience to the elucidation of the subject, we must confine ourselves to some selections from Mr. A. P. Boller's most able and exhaustive paper, which, in addition to exhibiting the scope of the proposed investigation, embraces his own views as to the composition of such a Board, and the method of its appointment and the direction of its responsibility, so entirely in accordance with our own views on the subject that we offer no apology for endeavoring to emphasize them. The divisions of the proposed work as arranged by Prof. Thurston were as follows:

ON ABRASION AND WEAR. *Instructions:* To examine and report upon the abrasion and wear of railway wheels, axles, rails and other materials, under the conditions of actual use.

ON ARMOR PLATE. *Instructions:* To make tests of armor plate, and to collect data derived from experiments already made, to determine the characteristics of metal suitable for such use.

ON CHEMICAL RESEARCH. *Instructions:* To plan and conduct investigations of the mutual relations of the chemical and mechanical properties of metals.

ON CHAINS AND WIRE ROPES. *Instructions:* To determine the character of iron best adapted for chain cables, the best form and proportions of link, and the qualities of metal used in the manufacture of iron and steel wire rope.

ON CORROSION OF METALS. *Instructions:* To investigate the subject of the corrosion of metals under the conditions of actual use.

ON THE EFFECTS OF TEMPERATURE. *Instructions:* To investigate the effects of variations of temperature upon the strength and other qualities of iron, steel and other metals.

ON GIRDERS AND COLUMNS. *Instructions:* To arrange and conduct experiments to determine the laws of resistance of beams, girders and columns to change of form and to fracture.

ON IRON, MALLEABLE. *Instructions:* To examine and report upon the mechanical and physical properties of wrought iron.

ON IRON, CAST. *Instructions:* To consider and report upon the mechanical and physical properties of cast iron.

On Metallic Alloys. *Instructions:* To assume charge of a series of experiments on the characteristics of alloys, and an investigation of the laws of combination.

On Orthogonal Simultaneous Strains. *Instructions:* To plan and conduct a series of experiments on simultaneous orthogonal strains, with a view to the determination of laws.

On Physical Phenomena. *Instructions:* To make a special investigation of the physical phenomena accompanying the distortion and rupture of materials.

On Reheating and Rerolling. *Instructions:* To observe and to experiment upon the effects of reheating, rerolling, or otherwise reworking; of hammering, as compared with rolling and of annealing the metals.

On Steels Produced by Modern Processes. *Instructions:* To investigate the constitution and characteristics of steel by the Bessemer, open hearth and other modern methods.

On Steel for Tools. *Instructions:* To determine the constitution and characteristics, and the special adaptations of steels used for tools.

What is wanted now is a more comprehensive law for the proposed new board than the one creating the old, and one fully recognizing the national character of the work. To this end the powers of the board should be fully defined, and all necessary provision made for its successful operation. Such a board should not be tacked on in any way to an army department, but should be an independent creation, reporting to the Secretary of the Treasury or the Secretary of the Interior. The work is almost entirely civil work, just as much as that of the Coast Survey, and should remain in existence as long as there is a metallic question, so to speak, remaining unanswered. Now that the testing machine is an accomplished fact, the board could profitably spend $50,000 per annum in experimenting, and the center of its operations should be in the city of Washington, to which point the testing machine should be removed from Watertown Arsenal, its present abiding place. The operations of the board should be reported in a yearly volume, such volume being readily obtainable by the scientific men and metal workers of the country, either by sale for the mere cost of publication, or a proper system of distribution, whereby the object of its publication would be accomplished. There is a tradition that an edition was published of the only report made to Congress by the old board, which, if true, has most successfully failed to reach the very class of men who could profit by it, leading to a vague suspicion that its distribution was based on political and not scientific methods. If *it is not* possible, under the existing methods of distributing public documents, to give the board absolute charge of distributing the yearly reports of their own work (and who, in the name of common sense, can better judge of where they should go), then the manner of distribution should be defined by the law creating the board. Too much attention cannot be paid to this branch of the board's work, since the very object of its creation would be defeated if the results of its work were not only accessible, but conveniently so, to all seeking such information.

We are now brought to the consideration of rather a delicate question, about which there are differing views, and that is the remuneration, if any, of the men engaged in the work of the board. This work, if properly followed up, would be an exceedingly engrossing one, calling for a practical abandonment for the time being of any other pursuit, and it would seem manifestly unfair to demand that such labor and sacrifice should be unrecompensed. Again, the great majority of men qualified for such work (and there are not many such available) would be deterred from accepting service on the board, to whose work they would otherwise bring great enthusiasm and attainment, from sheer financial inability to perform unrecompensed labor. Whatever is worth doing is worth doing well, and to expect qualified men to do thoroughly the work called for by such a board as is proposed, unrecompensed—a work, too, that will so richly compensate the American people—is expecting a degree of self-sacrifice that should not be looked for this side of Utopia, and should not be asked for. The only objection possible to urge against a paid board, all or in part, is the one usually attaching to government salaried positions or appointments, and the possibility, therefore, of unworthy or incompetent appointments. In other words, that the board would get into politics, and that the question of the chairman of the House Appropriation Committee, before related, would be asked with redoubled earnestness. Be this as it may, it should be thoroughly understood that the moment the proposed board takes on a political bias, its usefulness is ended. Its aim is purely a scientific one for practical ends, and as such must be established on its merits alone, and if this view is not prominently kept in the foreground, and made the basis of all legislation concerning it, the whole matter had better be dropped.

We must not be impatient for results, but ever bear in mind that the questions asked by the modern engineer are exceedingly complex ones, and that, while he would have been content a few years back to know the amount of strain an iron bar, for instance, would stand before rupture, he demands now to know the reasons that cause different bars to yield different results, or the same bar to yield different results under varying treatment; or why a small bar should behave differently from a large bar of the same material. All such answers require a long series of experiments, and the gathering of information from actual experience, besides chemical examinations hitherto deemed unimportant; and in regard to steel, all that is known is so little compared to what is yet to be learned about its properties and adaptations, that the field of research is almost appalling in its magnitude and intricacy.

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EADS' SHIP RAILWAY.

Inquiry is made as to the present status of this enterprise, and much misapprehension, if not ignorance, is shown as to the merits of the case, and the extent of the guarantee which the government is called upon to exercise. To meet this we cannot do better than to give some extracts from the Report of the Senate Committee, to whom was referred the bill (No. 430) to incorporate the Interoceanic Ship Railway Company.

After referring to expert testimony submitted to the committee from a great number of distinguished engineers and contractors, and others who are cognizant with works as nearly similar as at present exist in the world, bearing evidence to the entire practicability of a ship railway of the kind designed, and in the locality named, the committee refer to the report of a special committee of the House of Representatives of the Forty sixth Congress, who were charged with the duty of considering all questions relating to isthmean transit, and who, in the exercise of their duty, not only reported in favor of the Tehuantepec as the most preferable route, but in favor of Captain Eads' ship railway, and quote from the report of the special committee of the House, as follows:

"In the opinion of your committee, it would be a great mistake for the government of the United States to fail to recognize, in a substantial way, the overtures thus made by Mexico. The duty of our government in the premises is a plain one, whether viewed from a selfish or an unselfish standpoint. If viewed in the former light, it must be apparent to any one at all familiar with the enormous commercial interests which will be affected by the great work proposed that any liberality exercised by our government will be returned a hundred fold in the increased benefits resulting to our commerce. Of the valuable and growing commerce of Mexico, the United States now enjoys but 5 per cent.; 95 per cent. of it is enjoyed by other nations. The markets of Mexico are to-day practically closed to the products of our soil and industry, while there is no good reason why they should not be open to both.

"The combined commerce of British India, Australia, China, Hong-Kong, Peru, New Zealand, Chili, Japan, the Philipine Islands, Tasmania, and the Hawaian Islands amounts to $1,425,958,000 annually. Of this vast commerce the United States only enjoys 4 per cent., and the Mississippi Valley, comprising a territory equal in extent to six-tenths of the total area of the thirty-eight States of the Union, is wholly debarred therefrom. An increase of our trade, nearly doubling it in this quarter, would more than compensate the United States for the guarantee asked by Mr. Eads.

"Leaving out of view the question of interest, it would scarcely be consistent with the dignity and magnanimity of as great a country as ours to reject the friendly proffers of a sister-republic, and refuse to lend any assistance to a great work like that proposed; especially so in view of the revived fraternal feeling now existing there towards us."

And then proceed to say, that—"The concession which Mr. Eads has secured from the government of Mexico, which was first granted by the executive, and subsequently ratified by the Mexican Congress, is certainly a most liberal one. It gives to Mr. Eads a right of way across the isthmus half-a-mile in width, with an increased width at stations. It exempts the company and its property from all taxation, general or local, during the period covered by the grant, namely, 99 years. It gives to the company the right to import upon the isthmus, during the same period, all materials necessary for the construction and operation of its railway. It exempts the company from export duty on silver and bullion used by it either in the payment of dividends or of debts contracted abroad, and it makes a donation to the company of a million acres of public land.

"Mr. Eads does not ask the government of the United States to advance any money to construct the railway, but merely asks, and the bill provides, that the government shall guarantee the payment for the period of fifteen years of dividends at 6 per cent. per annum upon the par value of $50,000,000 of the capital stock of the company. It is estimated that the cost of constructing the work will be about $75,000,000, and the capital stock is limited by the bill to this amount. The guarantee of the government only attaches to the extent of two thirds of this capital stock. The bill provides that the guarantee shall not attach or have any force or effect until ten miles of the railway, and its terminal works, shall have been constructed and a loaded vessel shall have been lifted out of the water, transported over such ten miles of railway, brought back again, and again placed in the water without injury to the vessel, the railway, or the terminal works. When this has been accomplished $5,000,000 of the guarantee shall attach. When the terminal works, and ten miles of railway shall have been constructed upon the other side of the isthmus, and shall have been tested in the same manner, $5,000,000 more of the guarantee shall attach.

"The intermediate space between the two ten-mile sections is subdivided into twenty sections; upon the completion of each of these sections, and the successful transportation over it of a loaded vessel, proportionate amounts of the guarantee respectively attach, until the total amount of $50,000,000 is reached. All of these tests are required by the bill to be made in the presence of a board of engineers, to be appointed by the President of the United States.

"The committee do not consider it necessary to go into a discussion of the various provisions of the bill reported herewith. This bill has been carefully considered, and the committee are of opinion that under its provisions the government of the United States is amply protected against any ultimate loss by reason of its guarantee, and the government aid provided for is the least which our government could hope to give with a view of securing the construction and control of an isthmean highway.

"The consideration for the guarantee the committee believe to be most ample and satisfactory. The company is required by the bill to transport upon its railway, during the whole period covered by the Mexican concession, all government vessels, troops, munitions of war and mails free of charge; and it is further required during the like period to transport upon its railway all vessels belonging to citizens of the United States and registered under the laws of the United States for fifty per centum of the regular tolls and charges imposed for the transportation of vessels belonging to the citizens of any other country except Mexico. It requires no argument to show the immense advantage which this latter provision will secure to American shipping."

"The construction of the ship railway at Tehuantepec is a final solution, in the opinion of the committee, of the much-discussed question of isthmean control. If this railway be once constructed under the patronage of the U. S. government, it will supply the present demands of commerce, and will place the United States in such relation in regard to isthmean transit and its cognate political relations as will make it simply impossible for any foreign power to hereafter control any other transit across our isthmus; but if we refuse to lend assistance to a project, the successful consummation of which is now demanded by the commerce of the world, we invite foreign capital to embark in the enterprise, and the investment of foreign capital means the protection of foreign power.

"The committee do not consider that our government would be safe in permitting Mr. Eads to even organize an American company without government aid, because, upon the organization of such company, its stock would necessarily be exposed publicly for sale. It could be easily bought up by British capitalists; and a British board of directors, having invoked and secured the aid of their own government, could place us in the very position which we now seek to avoid. Should the government of the United States, however, give the desired aid, she will at once acquire certain vested rights from which she cannot be dispossessed.

"The Mexican concession only authorizes Mr. Eads or the company to obtain aid from one foreign government. Having obtained such aid, they have done all they had a right to do in the premises and no other government could acquire any rights whatever.

"The completion of the line of railroad from California to New Orleans has excited the alarm of the British capitalists whose ships have been carrying around Cape Horn grain from California to Liverpool. This railroad will be able to carry the grain to New Orleans, ship it through the jetties at the mouth of the Mississippi River and deliver it in Liverpool 80 or 90 days sooner than the English ships. The immense capital invested in the several hundred English vessels, and the lucrative character of the trade in which they are engaged, indicate too surely that such trade would not be readily abandoned or surrendered. The railroad companies have it in their power to so reduce their freight charges for carrying grain as to render competition upon the part of these English ships almost impossible, and having thus destroyed this competition would then be enabled to increase their freight charges to the highest rates the producers could bear. That they would so do is evidenced by the course which they have adopted under such circumstances.

"The owners of these English vessels have but one source to look to for relief, and that is a transit-way across the isthmus, by using which, the voyages of their vessels would be shortened by seven or eight thousand miles. It is idle to suppose that they will hesitate for a moment in promptly raising the capital necessary to construct the ship railway should the United States government decline to take control of it.

"Believing that the commercial interests of this country will be largely benefited by the construction of the ship railway, that it will have a tendency to infuse new life into our now languishing commerce, and that it is essential if our government would retain the respect of its own people and of foreign nations, that it should now practically demonstrate its determination to forever discourage foreign control upon this continent, the committee report back the bill favorably, with certain amendments, and with the recommendation that it do pass."

PROPOSED WATER-WORKS FOR CAMBRIDGE, MASS.

There is now before the Massachusetts Legislature a bill in which the City of Cambridge asks to be permitted to take an additional supply of water from the Shawsheen River, a stream of excellent pure water, which rises in the town of Lexington, and flows in a northerly direction through the towns of Lexington, Bedford, Billerica, Tewksbury and Andover, and empties into the Merrimack River near the city of Lawrence. The surveys, plans and estimates which have been prepared by the City Engineer of Cambridge, Wm. S. Barbour, C. E., Member of the American Society of Civil Engineers, show that at the point on the stream near the old Middlesex Canal, where it is proposed to take the water, in the town of Billerica, the minimum yield of river with the proper storage basins, is 20½ millions of gallons daily; the drainage area above this point is 84 square miles. The works contemplated are the construction of a dam across the valley near the old canal, 1,600 ft. long and 25 to 30 ft. high above the stream, thus creating a storage reservoir covering some 800 acres, and capable of holding about 2,000,000,000 gallons of water. The bill asks for permission to take a quantity not exceeding 8,000,000 gallons daily, and it is proposed to conduct the water by means of a suitable sized iron pipe, laid for the most part of the way in the bed of the old Middlesex Canal (abandoned many years ago). This forms a very direct and favorable route to Fresh Pond, the present source of supply of Cambridge. Here the water can be delivered into the pond, to be used as a storage reservoir, or directly to the pumps, which supply the consumption of the city, the elevation of the stream not being sufficient to supply the consumption direct.

The estimated cost of these works (exclusive of mill damages on the stream below the point of taking), is $700,000. The City of Boston also desires to take a portion of the Shawsheen for the Mystic supply, and is not opposed by Cambridge. Should the bills be granted to each, a more expensive scheme of works would probably be carried out with proportionate smaller cost of each.

There is also now in process of construction a separate system of high service supply for Cambridge. The work embraced in this plan is the erection of a 1,000,000 gallon pumping engine of the Worthington make, at the present pumping station, the laying of a new force main about ½ mile in length from the station to the present stand-pipe, a portion of which is to be used for the new supply; the laying of about 1½ miles of new supply mains to the more elevated portions of the city, which it is designed to supply, and includes those portions which are above grade 60. The old mains are separated from the new by check valves and gates at the proper points so that the old method of supply is not interfered with in the new. The plans for this work have been prepared by the City Engineer, and the work of construction is being done by the Superintendent of the Cambridge Water-Works, Hiram Nevons, Esq. Cost is estimated at about $10,000.

THE DENVER SOCIETY OF CIVIL ENGINEERS.

This, the latest engineering association, was organized Feb. 7 last. Its officers are John Pierce, President; Robert B. Stanton, Vice-President; Ed. H. Kellogg, Secretary and Treasurer; Arthur I. Fonda, Corresponding Secretary and Librarian. There is also an Executive Committee, composed of E. S. Nettleton, P. H. Van Diest and F. P. Swindler. The objects of the society are "the professional improvement of its members, the encouragement of social intercourse among men of practical science, the advancement of engineering in its several branches, and the establishment of a central point of reference and union for engineers in the Rocky Mountain region." To become a member "one must have been a civil, mining or mechanical engineer, in active practice as such for five years, or who has graduated as a civil engineer, been in practice for three years, and has had responsible charge of work as chief, resident or superintending engineer, for at least one year; not as a skillful workman merely, but as one qualified to design as well as to direct public work. The entrance fee is ten dollars. The society starts out with about twenty members, which includes the leading engineers in and about Denver. The constitution and by-laws are printed and can be had on application.

PERSONAL.

E. L. M. Hoare, Chief Engineer of the Chicago & Indianapolis Air Line, has resigned and is succeeded by L. B. Jackson. H. A. Lovell, Assistant Chief Engineer, also resigned.

John Lenthall.—Naval Constructor John Lenthall, United States Navy (retired), died suddenly at the Baltimore & Ohio depot in Washington this morning, as he was about to take the train for New York. He was in his 75th year, and was placed on the retired list in 1871. His health has been failing for some time. He was Chief of the Bureau of Construction and Repairs for a number of years.

Major M. F. Hurd and Frank P. Davis, Civil Engineers on the Denver & Rio Grande Western Railway, have resigned and accepted positions on the Canadian Pacific, with headquarters at Fort Calvary.

Oscar H. Peacock has been reappointed City Surveyor of the city of Rochester, N. Y.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 114.

CCLXV.—THE DALLES.

The Dalles, Oregon, in lat. 45° 36' 18" N., long. 121° 12' 8" W., is on the Columbia River at a point where it passes a cañon of basaltic rock, with a rapid descent. Settled in 1852, it was incorporated in 1858. Water-works were built in 1862 by Robert Pentland, taking the supply from a mountain stream of about 200 square miles watershed, in the Cascade Mountain range. A breakwater diverts water from the stream into a box conduit of 1½ in. fir plank, 8½ by 10-in. inside, which is laid underground and conveys the water 1½ miles to two reservoirs, one a stone basin 16 by 16 ft. and 8 ft. deep, the other, a natural rock basin, 75 by 150 ft. and 2 ft. deep, at 90 ft. above the city. An 8-in. cast-iron main leads from the reservoir to the city, where the distribution is by 1½ miles of 4-in. cast-iron pipe, with 6 fire hydrants, 8 gates and 400 taps. The town pays $100 per year each for 6 hydrants and 6 cisterns. Wrought-iron service pipes are used.

The population is about 1,200 and the daily consumption is 600,000 gallons.

The works cost originally $10,000. The cost now is $87,000.

The expenses in 1880 were $8,000 and the receipts $7,800.

Since 1877 Samuel L. Brooks has been the Superintendent and half owner, Robert Pentland owning the other half of the works.

CCLXVI.—TRINIDAD.

Trinidad, Colorado, in lat 37° 12' N., long. 104° 30' W., on the Las Animas River, is on the foothills of the Raton range of mountains, about 6,000 ft. above sea level. It was first occupied by Americans in 1875, and was incorporated as a city in 1879, in which year water-works were built by Delos A. Chappel, as a private enterprise.

The supply is taken from a well 25 ft. in diameter and 16 ft. deep, connected with a conduit or filter gallery 3 by 2 ft., and 300 ft. long, the walls laid dry and covered with flat stones. The well and gallery are in clean, coarse, saturated gravel near the river.

Two Cope & Maxwell double-acting steam plunger pumps lift the water 310 ft. through a mile of 12-in. pipe, laid through the heart of the town to a reservoir on high table land, 250 ft. above the main street, built in excavation and embankment, with the bottom covered with concrete overlying puddle and the sides paved with flat stones with cemented joints. It holds 2,000,000 gallons.

Distribution is by cast-iron pipe of 12 to 4-in. diameter; 5½ miles are laid, including the force main, which is also a distributing pipe. There are 32 fire hydrants, 25 gates and 265 taps; 150 meters are in use. The city pays $100 per year for each of 25 fire hydrants, and $70 each for additional ones. Wrought-iron service pipes are used, some of them cement-lined. The population is now 4,000 and the daily consumption 190,000 gallons. The works have cost $100,000. The expenses in 1881 were $6,000, and the receipts $10,000. There is no debt.

The works are owned by Delos A. Chappell. W. B. Cunningham is the General Superintendent.

CCLXVII.—BERWICK, PA.

Berwick, Pennsylvania, in lat. 41° 5' N., long. 76° 15' W., is on the North Branch of the Susquehanna River. It was settled in 1782, and incorporated as a borough about 1800.

Water-works were built by a private company in 1848, taking the supply from a spring on the river bank. A pump, driven by water-power from the canal in summer, and by a steam engine in winter, lifts the water 102 ft. into a small stone masonry reservoir. Distribution is by cast-iron pipe, of which about 2 miles are laid, with 2 fire hydrants and 300 taps. The borough does not pay for the use of hydrants. Lead and wrought-iron service pipes are used.

The population in 1880 was 2,094. The consumption is not known.

The capital stock of the company is $8,000. No other financial statements are given, except that there is no bonded debt.

S. B. Bowman is the Superintendent.

CCLXVIII.—BLOOMSBURG.

Bloomsburg, Pennsylvania, in lat. 41° 02', long. 76° 28', is on Fishing Creek, two miles above its junction with the Susquehanna River. The town is about one mile from this river. The country is level for a mile from the river. To the north and west it is then rolling, and to the south and east rocky and rough.

Settled in 1802 and then called Oystertown, it was incorporated as a town in 1870.

Water-works were built in 1880 by a private company, after the plans of Henry P. M. Birkinbine, C. E., taking its supply from Fishing Creek, which has its source in the North Mountain, a spur of the Alleghanies, thirty miles above the town.

Two 8-in. pipes conduct the water 50 ft. to the pump well whence it is lifted 180 ft. by two 6½-in. Birkinbine pumps driven by two 40 horse-power steam engines, arranged to work separately or together. For ordinary service, water is pumped into a reservoir built in excavation, 128 ft. in diameter at top, and lined with 18 in. of puddle. It contains 1,250,000 gallons, and is 154 ft. above the centre of the town. There are arrangements by which connection with the reservoir is cut off in case of fire and the pressure is raised to 125 lbs. to the square inch. When that pressure is exceeded, a safety valve discharges into the reservoir.

Distribution is by cast-iron pipe, 5½ miles of which, of from 10 to 4-in. diameter, are laid, with 49 fire hydrants, 20 gates and 175 taps. The town pays $1,200 per year for use of fire hydrants; service pipes are of galvanized iron.

The population in 1880 was 3,704. The daily consumption in 1881 was 46,925 gallons.

The capital stock of the company is $30,000. The works have cost $37,000. The bonded debt is $8,000 at 5 per cent interest.

The expenses and receipts are not given.

F. P. Bilmyer is the Secretary and Treasurer and E. Jabcoby the Superintendent.

CCLXIX.—PITTSTON.

Pittston, Pennsylvania, in lat. 41° 20' N., long. 75° 47' W., on the Susquehanna River, at the head of the Wyoming Valley, is on broken and hilly ground. The business part of the town lies along the river on low ground.

Settled before 1776, it grew slowly until the development of the coal fields in its vicinity. It was incorporated as a borough in 1853.

Water-works were built by a private company in 1855, taking the supply from the Susquehanna River, and pumping into reservoirs by a rotary pump, which was not successful in its operation.

A Worthington compound duplex steam engine of 2,000,000 gallons capacity, erected in 1877, and a Knowles double-acting plunger pump of 1,500,000 gallons capacity, erected in 1882, lift the water 166 ft. to a reservoir in excavation and embankment, holding 2,000,000 gallons, and 191 ft. to another reservoir holding 500,000 gallons.

Distribution from the reservoirs is by cast-iron pipe, of from 12 in. to 2-in. diameter, of which 15 miles are laid, with 27 fire hydrants in Pittston and 15 in West Pittston and 1,200 taps. Heretofore the borough has not paid for use of water, but a suit at law has just resulted in an order of court to pay $15 per year for each hydrant. Service pipes are principally of galvanized iron and some lead pipe.

The population supplied is 13,000 and the daily consumption 800,000 gallons.

The capital stock of the company is $76,350. The works have cost to the present time $106,593.50. There is a bonded debt of $14,000 at 6 per cent. interest. The expenses in 1880 were $6,000 and the receipts $17,000.

R. J. Wisner is President of the company. John

Anderson has been the Superintendent since organization.

A separate company was organized in West Pittston in 1871, to which water was furnished by an 8-in. pipe laid across the bed of the river. This company was purchased by the Pittston company in 1877.

CCLXX.—GENEVA.

Geneva, New York, in lat. 42° 52′ N., long. 77° 8′ W., at the foot of Seneca Lake, is in a gently rolling and very fertile region. Settled in 1787, it was incoporated as a village in 1806.

Water-works were built by a private corporation shortly after a charter was granted to it in 1797. The works were designed and built by W. S. Dezeug. The supply is taken from the "White Springs," and collected in two reservoirs, one 150 ft. square and 16 ft. deep. The other, 25 ft. lower, is 80 ft. in diameter and 7 ft. deep, and is 125 ft. above the lake and the lower part of the village. The distribution is by cast-iron pipes, of which 4 miles are laid, of from 10-in. to 4-in. diameter, with 24 fire hydrants and 800 taps. The village pays $60 per year for each hydrant. Service pipes are of iron. The population in 1880 was 5,861. The consumption is not given nor the cost of the works. There is a bonded debt of $85,000 at 6 per cent. interest. No further financial statements are furnished. A. L. Chew is the Secretary and Treasurer and S. S. Graves the Superintendent.

CCLXXI.—GREENWICH.

Greenwich, Connecticut, in lat. 40° 59′ N., long. 73° 39′ 4″ W., is on Long Island Sound. The surrounding territory is rough and rocky. It was settled in 1611.

Water-works were built in 1880 by a private company, after plans and under the superintendence of William B. Rider, C. E.

The supply is procured by gravity from an impounding reservoir on a stream of 4 square miles water-shed, 4 miles from the town and about 280 ft. above its lower portion.

The water is filtered through charcoal in flumes, with satisfactory results. It is then conveyed through 4 miles of 12-in. cast-iron pipe, and distributed by 2½ miles of cast-iron pipe of 8 to 4-in. diameter, with 26 fire hydrants, 28 gates and 120 taps. The town pays $1,000 per annum for use of fire hydrants. Lead service pipes are used. The population in 1880 was 7,965.

The capital stock of the company is $100,000. The works have cost $84,000. There is no debt. Further financial statements are not given. G. G. McHall is Secretary of the company, and W. B. Rider the Engineer.

CCLXXII.—DANVERS.

Danvers, Massachusetts, in lat. 42° 40′ N., long. 70° 57′ W., on Porter's River, an arm of the sea, is on rolling ground, rising from the sea-level to an elevation of 250 ft. It was originally a part of Salem.

Water-works were built in 1876 for the town, after the plans of George H. Bishop, C. E., by George H. Norman.

The supply is taken from Middleton Pond, 5 miles from the town. Its area is 106 acres and its water-shed 3 square miles. It is about 90 ft. above sea-level. A Worthington duplex tank engine of 2,000,000 gallons capacity, erected in 1876, and a duplicate of the same, erected in 1882, pump the water through a 12-in. wrought-iron and cement pipe 2.6 miles long to a reservoir on Hawthorne Hill, in the grounds of the State Insane Asylum, 280 ft. above sea-level, in excavation and embankment, and holding 5,000,000 gallons.

Distribution is by wrought-iron and cement pipe of from 12 to 4 in. in diameter. Twenty-nine and one quarter miles are laid, 17 of which are of 4-in. diameter. There are 196 fire hydrants, 169 gates, 881 taps and 20 meters. The sum paid by the town annually, out of taxation, for deficiency in revenue, amounts to about $25 per hydrant. Service pipes are of 1 in. wrought iron, cement lined. The population in 1880 was 6,500 and the daily consumption, in 1881, 400,000 gallons, including water fufnished to the Insane Asylum. The cost of construction had been to Jan. 1, 1882, $223,479.65. The State paid $12,500 of this and also pays $1,000 per annum for the Asylum supply. The gross receipts have been $56,140. The bonded debt is $205,000 at 4 and 5 per cent. interest.

The expenses in 1880 and 1881 were as follows:

	1880.	1881
For maintenance	$3,990.64	$6,561.60
For interest	9,000.00	9,500.00
The receipts from water rents were	10,108.76	11,205.11

The works are managed by three Commissioners, one of whom is elected each year. Benjamin E. Newhall is the Superintendent.

CCLXXIII.—MOLINE.

Moline, Illinois, in lat. 41° 30′ N., long. 90° 33′ W., on the Mississippi River, is on bottom lands about half a mile wide and bluffs back of them 150 ft. high.

Settled in 1843, it was incorporated as a village in 1858 and as a city in 1872. Water-works were built in 1877 by the city, after plans of M. A. Gould, the City Engineer.

The supply is taken from a pool above a dam built by the U. S. Government from the Illinois shore to Rock Island. This dam is of stone, 4,000 ft. long, 20 ft. high, 8 ft. wide at bottom and 4 ft. at top, with buttresses. The water is drawn from the channel to a settling basin through a box conduit, 14 by 36 in., of 2-in. pine plank, and 1,000 ft. long. From the settling basin it was pumped by a Knowles pump erected in 1879. A Worthington duplex pump was substituted for it on Jan. 1, 1882. Water is pumped directly into the mains, with an ordinary pressure of 45 lbs. and a fire pressure of 100 lbs. An intermittent supply is furnished to some consumers on the bluffs. It is proposed to build a reservoir in 1882 on the bluffs 150 ft. above the river.

Distribution is by 2½ miles of 8-in. and 6-in. cast-iron pipe, with 50 fire hydrants and 12 gates. The number of taps is not given. The pumps are furnished and run by a contractor in consideration of the payment by the city of $50 per year for each fire hydrant. The contractor also receives rentals from consumers.

The population in 1880 was 7,740 and the daily consumption 12,000 gallons in 1880 and 25,000 in 1882. Service pipes are of wrought iron.

The works cost $16,000, exclusive of the pumps. No further financial statements are given.

Some trouble has been experienced with anchor ice at the inlet.

The works are in charge of M. A. Gould, the City Engineer.

Acknowledgments.—The receipt of statistics as follows, is acknowledged with thanks: From W. B. Cunningham, general superintendent, statistics and water rates of the water-works of Trinidad, Colorado. From R. W. Bagnelt, superintendent, report of Plymouth, Mass., water commissioners for 1881. From John Anderson, superintendent, statistics and water rates of the water-works of Pittston, Pa. From W. B. Rider, C. E., statistics and water rates of the water-works of Greenwich, Conn. From Benjamin E. Newhall, superintendent, statistics and water rates of the water-works of Danvers, Mass., and reports of water board.

RAILWAY NECROLOGY FOR 1881.

LIST OF RAILWAY OFFICERS, FORMER OFFICERS, NOTED CONTRACTORS, ETC., WHO DIED LAST YEAR.

[From the Chicago Railway Age.]

JANUARY.

Charles R. Clement, general baggage agent of the Pennsylvania and Northern Central, died at Philadelphia.

General Charles B. Stewart, chief engineer of the Connotton Valley road, died at Cleveland, O., aged 67.

Benjamin Stevenson, formerly auditor of the Mobile & New Orleans.

Zebina C. Campa, great railroad contractor, builder of Vermont Central and other roads, died in Montpelier, Vt.

John B. Brown, prominent in the building of the Atlantic & St. Lawrence, Maine Central, Portland & Ogdensburg, and Portland & Rochester, died in Portland, Me.

Fred. P. Mosely, purchasing agent of the Old Colony railroad and steamship companies, died in Boston.

John S. Daily, cashier of the Chicago, Burlington and Quincy Railroad in Boston, and agent of the associated railways of Virginia and the Carolinas, died in Boston.

Joseph N. Stinson, general depot baggage agent of the Illinois Central, Michigan Central and Chicago, Burlington & Quincy roads, died in Chicago.

James M. Walker, general solicitor of the Chicago, Burlington & Quincy, president of the Union Stock-yards Transit Company, and formerly president of the Chicago, Burlington & Quincy, died in Chicago.

FEBRUARY.

Henry Waters, confidential secretary of General Superintendent Tillinghast, of the New York Central, was instantly killed January 8, by the falling of the roof of the Buffalo passenger depot.

General Robert Thomson, president of the Philadelphia & Erie Railroad Company, died at Philadelphia, aged 53.

A. D. Briggs, one of the railroad commissioners of Massachusetts, a civil engineer and bridge builder, died at Springfield, Mass., aged 61.

E. W. Strader, who was general passenger agent of the Little Miami road from 1848 to 1867, died in Ashtabula, O., aged 78.

MARCH.

Robert Hayes, superintendent of the Woodruff Sleeping and Parlor Coach Company, was run over at Cleveland by a locomotive and instantly killed.

Colonel Darius Hunkins, who was concerned in the construction of the Baltimore & Ohio, of which he was for a time superintendent, subsequently was a contractor on numerous Eastern and Western roads, and was president of the Keokuk Northern Line Packet Company, and president and superintendent of the Galena and Wisconsin, died in Galena, aged 69.

Captain Benjamin H. Fletcher vice-president of the Lockport and Buffalo Railroad Company, died at Lockport, N. Y.

L. B. Boomer, a well known bridge-builder in Chicago, died suddenly in New York. In connection with Mr A. B. Stone, he built the first bridge over the Mississippi River at Rock Island.

T. A. Brooks, master carpenter of the New York division of the Pennsylvania Railroad was killed by a locomotive near Trenton, N. J.

Benj. W. Healy, formerly superintendent of the Rhode Island locomotive works, died at Nicaragua.

Washington L. Hedge, traveling agent for the Red Line Transportation Company, died at Worcester, Mass., aged 51.

John G. Turner, formerly paymaster of the Terre Haute & Indianapolis road, died near Carthage, Mo.

APRIL.

Francis A. Stevens, inventor of the Stevens car-brake, died in Chicago.

Isaac N. Ross, director and formerly superintendent of the Boston, Barre & Gardner Railroad, died in Holden, Mass.

Hocum Hosford, for several years manager of the Boston & Lowell Railroad, died in Lowell, Mass., aged 57.

Edward Huntington, one of the engineers for the construction of the old Utica and Schenectady Railroad, and afterwards engaged on the enlargement of the Erie Canal, died at Utica, N. Y., aged 64.

Richard Meldrum, general western freight agent of the Pittsburg, Fort Wayne & Chicago Railway died at Jacksonville, Fla., aged 59.

William C. Longstreth, for many years President of the Williamsport & Elmira Railroad Company, died in Philadelphia, aged 61.

Thomas Hogg, who in 1837 took the first locomotive west of the Alleghanies, and was afterwards master mechanic on the Mad River & Lake Erie road and on the Sandusky, Mansfield & Newark road died in Danbury, Ohio, aged 73.

MAY.

R. J. Reekie, an extensive railway contractor in this country and abroad, and at one time connected with the Grand Trunk Railway of Canada, died in London, England, aged 70.

Judge John P. Devereux, for a long time land commissioner of the Kansas Pacific Railway, and subsequently in charge of the legal business of the Kansas Pacific and Union Pacific companies in Kansas, died at Lawrence, Kansas, aged 60.

Col. Thomas A. Scott, President of the Pennsylvania Railroad Company for many years and for some time president of the Union Pacific Railway Company and of the Texas & Pacific Railway Company and of many other corporations, died in Philadelphia, May 21, aged 57. He was previously general superintendent and vice-president of the Pennsylvania system, and during the civil war was assistant secretary of war.

Nathan Carruth, the first president of the Old Colony Railroad Company, died in Dorchester, Mass., aged 72.

S. T. De Ford, Jr., formerly western passenger agent of the Chesapeake & Ohio, and Southern passenger agent of the Pennsylvania Railroad, and in 1857, general freight agent of the Marietta & Cincinnati, died at Louisville, Ky.

JUNE.

Colonel George W. Flower, a well known Railway contractor of Watertown, N. Y., died in New York City.

Leonard Phlegar, inventor and mechanical engineer, who ran the first engine on the Philadelphia, Wilmington & Baltimore road, was at one time superintendent of that company's shops at Gray's Ferry, and afterwards in charge of the Philadelphia & Reading shops at Tamaqua, died in Philadelphia.

John M. Courtney, president of the New York & West Shore Railway, aged 56.

JULY.

James Abbott, chief engineer of the Continental Railway, and at one time chief engineer of the Rockfort, Rock Island & St. Louis died at Akron, Ohio.

William S. Hudson, the celebrated locomotive builder, an apprentice of Robert Stephenson, at one time the master mechanic of the Attica and Buffalo Railroad, and later superintendent of the Rogers locomotive works, died near Paterson, N. J., in his 72d year.

Colonel W. Milnor Roberts, the eminent civil engineer, died in Rio de Janeiro, South America, aged 72. He had charge of the surveys of several of the great railways of this country, made plans for the great St. Louis bridge, and at the time of his death was chief engineer of public works for Brazil.

James Robb, formerly president of the Chicago & Alton Railroad Company, died at Cincinnati.

AUGUST.

Joseph H. Moore, formerly superintendent of the Old Colony Railroad, then of the Michigan Central, later of the eastern division of the Pittsburg, Ft. Weyne & Chicago, and subsequently connected with other roads, died at Odell, Ill., aged 68.

Thomas J. Firth, for many years secretary and afterward treasurer of the Pennsylvania Railroad Company, with which he was connected for thirty-three years, died at Germentown, Pa., aged 78.

Lieutenant Colonel F. W. Cumberland, general manager of the Northern and Northwestern railways of Canada, died in Toronto.

General John A. Clark, land commissioner of the Kansas City, Fort Scott & Gulf Railroad, died at Kansas City.

William G. Fargo, President of the American Express Company, died in Buffalo, N. Y.

William H. Cruger, civil engineer and railway builder for many years, and latterly agent at Peoria for the pooled lines, died at Peoria, Ill, aged 60.

Eber E. Aldrich, superintendent of the Troy & Boston Railroad, died in Troy, N. Y.

Wm. Tomlin, general agent of the Naugatuck Railroad, died at Bridgeport, Conn., aged 57.

James C. Slocum, a prominent railroad contractor, died suddenly at Bradford, Pa.

James H. Williams, director and treasurer of the Rutland Railroad Company, and a director of the Vermont Valley and Cheshire Railroad Companies, died at Bellows Falls, Vt., aged 69.

William Gooderham, who was largely interested in Canadian railways, and whose son is president of the Toledo & Nipissing, died at Toronto, Ont., aged 91.

Colonel Joseph Applegate, formerly president of the Pittsburg, Wheeling & Kentucky Railroad, died at Wellsburg, W. Va., aged 78.

Royal Hill, of Chicago, of the firm of Hill & McKechney, railway contractors, died at Irontown, O., aged 68.

Philo Morehouse, claim agent for the Lake Shore & Michigan Southern road.

George W. Jones, chief of the Car Service Department of the Pennsylvania Railroad, died near Philadelphia, aged about forty years.

SEPTEMBER.

Thomas C. Harvey, master bridge-builder of the Atlanta & Charlotte Air Line, was killed by being struck by a freight train and thrown from a bridge.

Joseph Harvey, lost freight agent of the Michigan Central Railroad, died in Chicago.

George Nason, Superintendent of the Pensacola Railroad and Steamship Company, and for many years division superintendent of the Louisville and Nashville, died at Mobile, Ala.

C. M. Whittier, cashier of the Boston, Concord & Montreal Railroad, died in Littleton, N. H.

Willard Ricketts, formerly president of the Jeffersonville, Madison and Indianapolis road, died in Indianapolis, Ind., aged 63.

Major-General Ambrose E. Burnside, United States Senator from Rhode Island, who was formerly treasurer and director of the Illinois Central, president of the Rhode Island Locomotive Works and president of the Indianapolis & Vincennes and Cincinnati & Martinsville railroad companies, died in Bristol, R. I., aged 51.

John W. Brooks, formerly president of the Michigan Central and the Chicago, Burlington & Quincy companies, died at Heidelberg, Germany.

E. S. Duvol, superintendent of bridges and buildings of the Ohio & Mississippi.

S. C. Scoville, secretary of the Nevada & Oregon Railroad, died from wounds received in a fight at the annual meeting of the company.

OCTOBER.

B. B. Prevost, civil engineer, who was engaged in the construction of the Michigan Southern and Illinois Central roads, died at Dubuque, Ia.

Hon. Edwin B. Morgan, one of the founders of Wells, Fargo & Co., and largely interested, died at Aurora, N. Y., aged 75.

NOVEMBER.

George Hibbert, formerly master car-builder of the Cincinnati Southern road, died at Chattanooga, Tenn.

E. B. McClure, for six years general superintendent of the Indianapolis road, died at Lichfield, Ill.

George Law, a well-known railway builder and owner, one of the builders of the Panama Railroad, and engaged in various steamship and railwey enterprises, died in New York, aged 75.

Theodore S. Faxton, first president of the Utica and Black River road, died in Utica, N. Y., aged 87.

William Rushton, for many years master mechanic on the Atlanta and West Point road, died at Atlanta, Ga.

DECEMBER.

E. F. Casement, a well-known railroad contractor, who was largely interested in the construction of the Union Pacific and many other roads, died in New York.

Henry G. Stebbins, once president of the Atlantic & Great Western and Texas & Pacific railroad companies, died in New York, aged 79.

Dr. A. Teal, many years ago a master mechanic of the Chicago, Burlington & Quincy, died at Dunlap, Iowa.

Colonel J. T. Snead, president of the Continental Railroad Company, died at New York, aged 61.

Henry C. Wentworth, for many years general passenger and ticket agent of the Michigan Central Railroad, died in Chicago, December 28, of a spinal affection from which he had long suffered.

LITERATURE.

A PLAT AND PROFILE BOOK FOR CIVIL ENGINEERS AND CONTRACTORS. Published at office of ENGINEERING NEWS, 1882. Price, $1.

Every engineer knows how troublesome and tedious it is to have to carry a long roll of profile for reference in the field, or to roll and unroll from end to end in an office. The writer, who has had a large experience in railroad surveying and construction, has endeavored to assist himself and his brother engineers by preparing for use his "Plat and Profile Book." In his Preface he says: "Engineers are aware that in the construction of railways and public works much valuable time is lost in looking through transit and level books, and in referring to office plans and profiles for notes and data that must be frequently used in the field. The writer has found a pocket-book of this size convenient for mapping to scale (400 ft. to 1 in.), and recording notes of alignment, right of way, reference points, bench marks, etc., which, in the work of construction, are no less important than the profile itself. The few tables copied from Trautwine's valuable 'Pocket Book' are inserted for reference in the field, the table of quantities being especially for the convenience of contractors, who will also find the left-hand page of the book of much service for noting amounts of estimates and dates of sub-contracts. The book is made up of three pages of tables, one of excavation and embankments, for 100 ft. prismoids, slope 1½ to 1; bases, 12 to 28 ft., and height, 6 in. to 100 ft.; a table of strength and weight of various materials, giving tensile strength, crushing load, weight per cubic foot, and weight of bar iron in pounds, and a table showing the number of acres of covered (as in cities) surface, from which circular sewers, with junctions properly connected by easy curves, will convey away the water-fall of a rain of one inch per hour, with house drainage besides, giving slope of sewer from level to 1 in 60, with sewer 2 ft. to 10 ft. diameter; there is a page for index, and then 37 pages are devoted to profile paper, neatly engraved, and allowing three sections, or thirty ordinary divisions to the page, usually equal to 3.000 ft. length, by four divisions, or 100 ft. height. The opposite pages are blank. The book is bound in flexible covers, and is 9½ in. long by 4 in. wide, and less then a quarter inch thick. It supplies, in a convenient shape, a long-felt want among engineers, surveyors and contractors, and the price—one dollar—places it within easy reach of a trial of its merits. They are for sale wholesale and retail, at this office only, and we invite the attention of the profession to it as a convenient book of reference and a labor-saving contrivance prepared specially for them.

SEWERAGE OF EUROPEAN CITIES.

PART IV.—VIENNA.

Population.

City proper	730,000
Contributing to sewers, over	1,000,000

Area.

City proper (4,200 hectares) acres	10,379
Sewerage area (6,300 hectares) "	15,568

Dwellings.

Number of houses	12,[illegible]74
Number of dwellings	143,617

Water Supply.

Max. daily which can be delivered, gallons	29,847,033
Daily summer consumption "	16,441,985
" winter " "	12,705,183

Obtained from mountain creeks by gravity for domestic purposes, about 16 gal. per head daily.

Mortality.

Varies from	28.2 to 38.7
Mean for several years	30.6

Meteorological.

	Fahr.
Temperature, mean annual	49.46
" highest	101.84
" lowest	13.00
Mean max. annual	93.02
" min. "	4.82
" summer months	67.10
" winter "	31.00
" yearly rainfall (inches)	23½
Max. " " "	31

Topographical.

Situated on the right bank of the Danube, the city is intersected by the Donau Canal, a branch of the river. The surface between the latter and the Danube is almost a level, and is 13 to 18 ft. above the low-water level. The rest of the city is on a gradually sloping and undulating ground, closed in by hills.

Physical.

The flat territory between the canal and the river is mostly open; a small district near the former is built up. In the northwest, the ground is as yet unimproved or covered with scattered buildings. In the southwest, the territory is converted into a park (Prater). The pavements are granite blocks, and recently have been replaced by asphalt to some extent. In open territory they are macadam.

MANAGEMENT OF PUBLIC WORKS.

All public works are under a "general director." The separate departments are as follows:

I. Architecture, for public buildings and grounds.

II. Water supply.

III. Rivers, canals and sewerage; headed by a chief engineer, with a staff of two principal assistants, one for each half of the city, eight assistants, for general design and maintenance, and a large staff of clerks and inspectors.

IV. Streets and bridges, and

V. Fire department.

The yearly budget is about $8,000,000. New works, as well as the maintenance of existing works, are done by contract.

DESIGN AND CONSTRUCTION OF SEWERAGE WORKS.

I.—GENERAL SYSTEM AND ALIGNMENT.

Combined water-carriage, with some dry removal, which is gradually being abandoned. System is not satisfactory on account of many old and improperly designed works. New works are gradually replacing and supplementing them. Since 1859 the question has received systematic treatment. All sewage discharges into the Donau Canal. At present there is a project to build an intercepting sewer along its entire eastern bank, discharging into the Danube several miles below the city. The Wien River is preserved from contamination by an intercepting sewer on each shore; a third one protects the extensive flat ground in the south from the storm-water of the adjoining high grounds. The rest of the sewers are along the valley lines, several of them inclosing creeks originating in adjacent mountains.

II.—IN STREETS, ETC.

Shape and size of sewers.

Pipe sewers are not used, but will shortly be introduced for house branches only. The shape of the sewers is oval, the invert is rather flat, with a radius but a little less than that of the arch. The older sewers, especially those carrying creeks, are of various shapes, generally with a level bottom and semicircular arch. The débris is less likely to block up a flat bottom than a semicircular one. The sewers are all sufficiently large to be entered, which requirement determines their minimum size. The capacity is calculated, according to Darcy and Bazin's formula, in the following form:

$$\text{Mean velocity per second} = \sqrt{\frac{\frac{\text{sect. area}}{\text{perimeter}} \times \text{sine of slope}}{A + B\frac{\text{perimeter}}{\text{sect. area}}}}$$

$A = .00019$; $B = .00013$.

Formerly Eytelwein's formula was used. The maximum rainfall calculated to be provided for is over 1 in. per hour, supposing ¾ of an inch to get into the sewers, and to fill them only to the spring. The sizes are divided into types, with the dimensions as follows, in meters:

Type	Height at key.	Width at spring.	Invert radius
I	1.10	0.80	0.338
II	1.20	0.84	0.35
III	1.35	0.90	0.367
IV	1.50	1.00	0.42
V	1.65	1.10	0.45
VI	1.80	1.20	0.50

For house branches the size ordinarily used is:

VII	1.05	0.60	0.32

Larger sewers, with spans to 20 ft., with flat bottoms, are used for carrying old creeks.

Depth and grade of sewers.

The depth of sewers below the pavement varies in general from 10 ft. to 15 ft.

The grades, on account of the undulating surface, are as a rule very good. The maximum grade is 0.027 (1:37). The minimum grade is 0.0016 (1:608). The grade for the intercepting sewers is 0.0022 (1:455). The common grades for ordinary sewers are about 1:100.

Junctions, connections, overflows, outfalls.

Junctions of sewers are usually built at 45°, or are tangential, with comparatively small radius. Sewers which are too large ever to get filled join the others at 70 to 90°.

The house branches usually terminate at right angles, as in Paris.

Overflows are built at various places in the two intercepting sewers along the Wien River.

For the proposed main interceptor along the Donau Canal, overflows will be put opposite every valley-line sewer discharging into it.

All the present outfalls are along the Donau Canal at different elevations, varying from mean to ordinary high water. They are unsightly and obnoxious.

(TO BE CONTINUED.)

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* From Rudolph Hering's report to the National Board of Health.

THE ORGANIZATION AND EXPENSE OF A FORCE TO LAY ONE MILE OF TRACK A DAY.

(Written for ENGINEERING NEWS by W. M. JOHNSON, TEMPLE, Bell County, Texas.)

As an example to some one who may wish to engage in track-laying, where one mile a day is required, I will give the figures from actual experience now in use.

THE ORGANIZATION.

The tie-wrestlers: 1 panel-spacer, 1 tie-surfacer, 2 tie-liners, 3 unloaders, 6 tie spreaders—18 men and a water-boy.

The iron-gang: 1 gauger, 2 heelers, 2 unloaders, 6 iron men—11 men and a water-boy.

The front-gang: 1 tie-spacer, 1 spike-peddler, 2 nippers, 4 spikers, 5 strappers—13 men and a water-boy.

The tie-loaders—16 men, in 4 gangs of 4 each, and a water-boy.

The back-spikers: 1 tie-spacer, 2 spike-peddlers, 4 nippers, 8 spikers—15 men and a water-boy.

The lining-gang—5 men and a water-boy.

The back fillers—15 men and a water-boy.

Besides the above there is a man on the tool-car to take care of and repair the picks, shovels, mauls, etc.

Making a total of 89 men, 7 foremen, 8 water-boys, and 18 teams, viz.: 16 hauling ties, 1 pulling the iron-car, and one hauling water to the boarding-train.

At the teamsters' camp there is also a camp-boss, who takes care of the forage, harness, etc., a blacksmith and a night-watch.

Also there is a superintendent of track-laying, a general manager for the contractors, a bookkeeper, and a night-watch at the boarding-train

Expense each working-day:

1 superintendent or manager		$5.00
1 bookkeeper		4.00
7 foremen	@ $3.00	21.00
4 men	@ 2.25	9.00
24 men	@ 2.00	48.00
18 teamsters	@ 1.80	32.40
65 men	@ 1.50	97.50
8 water-boys	@ 1.25	10.00
Feeding 40 mules		15.00
Fuel and wages on train		24.00
10 per cent. for wear and tear		26.00
Total		$292.50

The 24 men at $2.00 each include the 11 iron-men, 12 spikers and the tool-man.

The 4 men at $2.25 are the camp-boss, the blacksmith, and the two night-watches.

The teamsters get $30 per month and board,

The 7 foremen include the wagon-master, and the 8 water-boys include 1 for the teamsters, and supposing the amount paid by the men for board will balance the expense thereby incurred no account is taken of the labor and store-bill of the boarding-train, but $3.50 per week per man will just *only* pay out.

WORKING THE ABOVE FORCE.

The panel-spacer with his 30-ft. pole and pick keeps far enough ahead to do duty as the road-maker.

The 2 unloaders in the iron-gang assist in loading the iron-car, and while this is being laid they throw off from the flats another iron-car load of 30 rails.

The front gangs of spikers (a pair on each rail) spike 3 ties in each panel, always the joint and the sixth and eleventh ties, skipping 4 ties each time.

Of the 5 strappers one untrims the plates, leaving plates, nuts and bolts on the joint-tie, and the other 4, working 2 on a side, strap up and bolt the joints.

The tie-loaders also unload the ties from the flats as fast as needed.

Should the back-spikers get behind they are assisted by the front-spikers whenever material runs short.

Should the back-fillers get behind they can be reinforced by the tie-gangs, and the iron-gang and strappers can put in the sidings.

The 16 teams have 14 loads of 12 ties each per day, making 2,688 ties.

THE MATERIAL-TRAIN.

As the ties and steel are delivered to the track-contractor at the last side-track, and these are about 8 miles apart, the haul is never long to the front.

The train is made up of 10 cars of ties in the rear and 3 cars of steel in the front of the locomotive, or just enough material for a half-mile, and is at the boarding-train at 6 o'clock a. m., in time to take the force to the front as soon as they breakfast.

The back-fillers, liners and back-spikers are dropped where they stopped work, and the 10 cars of ties are left far enough back to give the train room to pull off the unloaded steel for the iron-car to get at it.

The 10 cars of ties are moved up as fast as the track will allow, so as to make the haul as short as possible, and only enough are unloaded at each time to keep the wagons busy and prevent any delay.

At noon the train carries the force back to dinner, and the empty flats are side-tracked, and another load of 10 cars of ties and 3 of steel brought up to the boarding-train in time to take the men back after dinner.

The ties are loaded generally, 135 to a car, or 20 cars to the mile, while the steel is loaded 60 bars to the car, or 6 cars to the mile.

In loading the iron-car only 30 rails are put on each trip.

Only one train is used in this work, and where water may be scarce, a 100-bbl. water-car is added.

The hauling of all bridge, depot, tank, telegraph and other material is left to the trains that supply ties and steel to the contractor.

The track is not surfaced by this force; but enough material is put on the track to keep the ties squared and spaced.

The back-spikers (2 gangs on a side) spike 6 ties each, instead of 3, as with the front-spikers, and in this way seem to do double duty; but as they are not detained by the movements of the train, or the iron-car, they accomplish it.

A push-car accompanies them to pick up all loose spikes, nuts, bolts, etc., thus requiring 2 spike-peddlers.

As the front-spikers spiked the 1st (joint), 6th and 11th tie in each rail, there are 12 ties left for the back-spikers, and the front pair spike the 3d, 5th, 8th, 10th, 13th and 15th ties, leaving as many more for the other pair.

The teamsters' camp is moved up every Sunday to some suitable place about four miles beyond the end of a track.

The force as above organized can lay 1¼ miles steel per day, but cannot keep up the back work and lay much over one mile.

GENERAL REMARKS.

We are laying 50-lb. steel rail, square and supported joints, fish-plates, no nut-locks, ties all full spiked, 15 to the 30-ft. rail, spaced 2-ft. centers, square to the track, laid to a line on the right-hand side.

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ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The society met Wednesday evening, April 19, Maj. Geo. W. Dresser in the chair; Mr. John Bogart, secretary.

The deaths of two members were announced: Prof. C. G. Forshey, of New Orleans, and Capt. C. W. Howell, Corps of Engineers, U. S. A.

Mr. Ricardo Orozco, C. E., of Mexico, exhibited and explained the plans and profiles of the proposed works of drainage of the valley and city of Mexico. The explanations were translated by Mr. Theophilus Masac, C. E.

The city of Mexico is situated in a basin without natural outlet. The Lake Texcoco, within a very short distance of the city, in times of flood overflows and affects deteriously the city to such an extent that its sanitary condition has become very bad.

A short distance further from the city are the lakes Chalco and Xochimilco, which also overflow towards the city.

Three other lakes at more considerable distances are in the same basin. There are no natural outlets, only evaporation lowering the areas of the waters.

The extreme desirability of securing drainage from this basin has been long felt.

In the 17th century Señor Enrico Martinez, an engineer under the Spanish authorities, constructed a tunnel partially through the mountain Nochistongo, which, however, never was entirely completed. Many years afterwards, Jesuit fathers made an open cut down to the tunnel. This work cost a very large amount of money and many lives. Proper slopes were not maintained, and the earth caved in frequently.

The drainage has never been properly kept up. Señor Orozco's plan is to construct an open canal upon such grade as will entirely drain the lakes Xochimilco, Chalco and Xaltocan, and also maintain at regulated surfaces the lakes Texcoco and Zumpango.

Through the city of Mexico are to be constructed sewers flushed by the waters from the lakes, which are carried to a common conduit; where the sewage is purified by deposition, the solid matter to be used for fertilization and the water carried away in the canal. The whole length of the canal would be about 50 miles; expense about $7,000,000.

Maps, profiles and plans executed in a remarkably fine manner were exhibited.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The spring meeting of this society was held this week, commencing on Wednesday, at Philadelphia. The Engineers' Club extended the use of their rooms to the society as headquarters, and the sessions for reading papers were held in the lecture-room of the Franklin Institute. Excursions were made to the several points of interest about the city, a reception by the citizens of Philadelphia was given on Wednesday evening, and the society subscription dinner was given on Thursday evening. The following papers were announced to be read at the meeting:

"Results of a Test of Upright Boilers and Pumping Engine."—J. S. Coon.

"The Chronograph for Engineering Purposes, with the Hipp Escapement."—W. R. Eckart.

"On the Several Efficiencies of the Steam Engine."—Robert H. Thurston.

"The Thermodynamics of Certain Worthington and Other Compound Pumping-Engines."—S. W. Robinson.

"Determination of Heating Surface of Ventilating Flues."—Wm. P. Trowbridge.

"Note on the Economy of the Windmill as a Prime Mover."—Alfred R. Wolff.

"Screw Propulsion."—John B. Root.

"A Standard Gauge System."—George W. Bond.

"Description of the Edison Steam Dynamos in the New York Central Station."—Thomas A. Edison, Ph. D., and Charles T. Porter.

"On Rankine's theories relative to the Economy of Steam in the Cornish Engine."—Wm. P. Trowbridge.

"A Comparison of Turbines."—Samuel Webber.

"Steam and Air Economy."—Samuel McElroy.

"Steel Ships and Modifications of Models to meet the requirements of the Ocean Carrying Trade."—Henry W. Gorringe.

"Experiments on the Specific Heat of Platinum."—John C. Hoadley.

"Positions of views upon Mechanical Drawings."—A. Faber Du Faur.

"Belts connecting Pulleys in Non-Parallel Shafts."—Prof. J. B. Webb.

"Note on the Action of a Sample Mineral Wood used as a Non-Conductor Around Steam-pipes."—Prof. Fred. Hutton

"Built-up Work in Engine Construction."—Horace See.

"Efficiency of the Steam Boiler."—R. H. Thurston.

"A Spring Fan for Poppet-valve Drawings."—Gracio Curtis.

ENGINEERS' CLUB OF PHILADELPHIA.

RECORD OF REGULAR MEETING—APRIL 1, 1882.

President Rudolph Hering in the chair. Twenty-five members and two visitors present.

Mr. C. S. d'Iuvilliers read a description of the construction of the Philadelphia & Long Branch Railway.

Mr. D. McN. Stauffer read a paper upon "Brick-work under Water-pressure." During the construction of the tunnel under Dorchester Bay, in Boston, it became necessary to construct a brick bulkhead that had to withstand the pressure due a water column 162 ft. high, and as it was intended to shut off a leak amounting to 240,000 gallons per 24 hours, it had to be water-tight.

The tunnel section at the point selected for the bulkhead was practically 10 ft. square. The bulkhead was built directly across the tunnel, 50 ft. in front of the heading where the water was struck. Plank dams filled with puddle clay were first thrown across the tunnel, each side of the bulkhead site, and a 6-in. wrought-iron pipe used to carry off the water during construction—the pipe being built into the brickwork. An arched form was adopted, 4 ft. thick at the crown and 2 ft. rise in a span of 10 ft. Hard, burned bricks were used, laid in mortar made of one part Eng. Portland, one part Newark Rosendale, and two parts clear, sharp sand—a compound found equally as strong as Eng. Portland and sand one to one, and having the advantage of working smoother on the trowel, and adhering better to brickwork in wet places. Skew-backs for the arch were roughly picked out in the rock at the sides. After the cement had set, the water was shut off by screwing a cap on to the outer end of the 6-in. cap. The pressure against the wall was 72$\frac{1}{10}$ lbs. per square inch, or about 519 tons distributed over the face of the bulkhead. The wall was tight for about 48 hours; then the water came through the *brick* itself, rather than through the joints, in amount equal to one-half the original volume.

The water was let off and a second experiment tried. The main wall was torn down sufficiently to allow men to pass behind it, and a second wall only 12 in. thick was built back of the first, and 2 ft. distant. The space between these walls was well rammed with puddle clay, extending to the rock on all sides. The second wall was made purposely light, as its yielding to the pressure would only more effectually consolidate the clay between it and the unyielding wall in front. The bond used in the main wall was one so laid that there was no continuous horizontal joints through the wall.

The result of the last construction was to completely shut off the water from this leak, at a great saving of fuel and pumps. The Dorchester Bay tunnel is 7,000 ft. long, with its average invert grade 143 ft., below low-tide mark in the bay under which it passes. The tunnel is driven through a formation of clay, slates and conglomerates for its entire length; rock, very seamy, and much water encountered.

Mr. E. V. d'Invilliers read a paper by Mr. O. B. Harden, of the Pennsylvania Geological Survey, entitled "Topographical and Geological Modeling," in which the method pursued by the survey was explained, and the text illustrated by photographs and models. The requisite for a good model is a good contour map of the ground to be illustrated, with contours 10, 20 or 100 ft. vertically apart. The lumber used by cigar-box makers is best suited for modeling—of a thickness required by the vertical scale. On a scale 1,600 ft. to an inch the boards will be $\frac{1}{16}$ of an inch thick and represent 100 ft. in height. The contour line marked upon the base and the one next above it are traced upon boards cut the exact size of the base, and the lowest or outer one of the two is sawed through by a jig-saw, the upper or inner one serving to mark the place for the next succeeding board. These are nailed on with sprigs—glue being used where from the sharpness of a piece a nail would split the wood. The wooden model is then waxed—the wax being worked down until just the edges of the boards are seen, and until it presents a smooth appearance and facsimile of the topography. The model is then rubbed with linseed oil, and is then ready for casting in plaster of Paris. Care should be taken to get the oil in on the low places, as on this depends the facility with which the negative can be removed after the setting of the plaster. A cast is then made with plaster of Paris, filled in around a frame to the requisite thickness, and, after being allowed to dry for about an hour, it is removed from the original, smoothed up with a file or knife edge, and coated with shellac varnish. From this cast a positive is made—pursuing the same method as before—and is dried and scraped. The sides are smoothed up for the sections, and after being varnished the model is ready for the coloring—representing the different geological formations. Streams and geographical features being added, the model is complete.

HOWARD MURPHY,
Secretary and Treasurer.

CORRESPONDENCE.

DECIMAL METAL SCALE.

LAKEVILLE, Ct., April 17, 1872.

EDITOR ENGINEERING NEWS:

Having for a long time felt the want of a good, handy decimal metal scale, I would say that during the past winter Stephens & Co., of Riverton, Ct., manufacturers of folding rosewood rules, have made me one of German silver, 1 ft. long, 1⅛ in wide and about $\frac{1}{10}$ of an in. thick, graduated on one edge on each side to inches and $\frac{1}{10}$ths the whole length.

One other side metrically beginning at the center and running each way to the end of the scale, each about 158 divisions.

The other side is graduated to feet and $\frac{1}{100}$ths the whole length.

The scale is well made in every particular.

If some dealer would order a quantity, I don't know but that it could be retailed for $2, and at that price a boxwood scale, with its liability to warp, is no object to a draftsman.

D. B. & Co.'s triangular German silver scales are not made any more. Their being only partially divided and their high price were great objections. Any order Stephens & Co. may receive will not benefit me. My only object in referring to the scale as I have is because it deserves it.

To find what degree a curve is on: Take a wire 61.8 ft. long; stretch it tight and straight along the inside of rail; from the middle of the wire measure the distance to the rail; every inch so measured represents a degree of curve.

NIMROD.

MAXIMUM STRESSES.

PORTER, Ark., April 12, 1882.

EDITOR ENGINEERING NEWS:

Having just received your paper for April 1, I notice that in the communication on Maximum Stresses in that number I have given only the expression for the maximum compressive stress in the top flange, and have omitted that for the maximum tensile stress, which cannot exceed $\frac{P}{A} + \frac{Pet}{I} - \frac{Mt}{I}$, in which M is that due to the weight of floor, etc., and the other notation is the same as before. By giving a place to this addition, you will oblige.

Yours truly,
JOS. A. BEAUMONT, C. E.

MAXIMUM STRESSES.

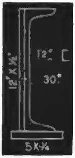
SPRINGFIELD, Mass., April 15, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: I was much gratified that my little inquiry about beams subjected to both permanent tensile and occasional girder strain called out so able a reply as that of Mr. Joseph A. Beaumont, C. E., especially as I have never happened to see the case treated in books.

His formulæ are excellent, and correct as far as I have analyzed them, and we disagree only on one point, as to resultant of permanent tension. He locates it in the center of a link chord, but says it is inadmissable to use it in a riveted truss. Of course, at the joints of a riveted truss there are cross strains, etc., impossible to calculate, but I contend that in center of panel, say 10, the chord tension is practically and virtually distributed equally over net area of chord, and its resultant acts in center line of gravity of chord section. This is always assumed in dividing whole strain by area to get strain per square inch. If strain on each inch of area were not assumed equal no such calculation would be possible. Assuming this for the present it may be of interest to give the actual case referred to.

Chord strain (center panel) was 284,600.
Girder strain at lower edge of [was 59,800.
My section was



2 12 [s net area.... .... 15.3
2 vertical plates, 12 × ½.. 9.5 24.8
2 bottom hor. plates, 5 × ¾ 6. 30.8

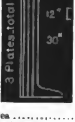
The bottom plates were not to be continuous, but to be separated a foot or so at panel points, so the chord strain 284,600 would be taken by 24.8 area, and the girder tension of 59,800 by the 6 net area.

By Mr. Beaumont's formula

I net = 662, e = 1.27 and t = 5,475.

$$\frac{P}{A} + \frac{Mt}{I} - \frac{Pet}{I} = 9{,}110 \text{ lbs. per square inch.}$$

The engineer's section was as follows. He called for the same channels, and plates enough for chord strain, besides:



2 12 [s net area .... 15.3 }
6 plates, total net area............ 27.1 } 42.4

I = 666, net moment of inertia,

then

$$\frac{P}{A} + \frac{Mt}{I} = 9{,}830 \text{ lbs. per square inch,}$$

which, while coming within the limit, wastes a large amount of iron in upper half of chord.

Now, make my bottom plate say 6 × 1. Then t = 5.14 I = 7.67 net, and net area = 34.8,

$$\frac{P}{A} + \frac{Mt}{I} = 9{,}960 \text{ lbs.,}$$

which is very near the engineer and weighs 141 lbs. per foot against his 166 lbs. per foot.

My first section was 126 lbs. per foot.

This is without using the central force Pe at all.

I have taken $M = \frac{Wl}{12}$ for girder moment in center panel, as the girder is continuous or fixed at each end.

Truly yours,
W. H. BURRALL, C. E.

BRIDGE FAILURES.

OAKLAND, Cal., April 10, 1882.

EDITOR ENGINEERING NEWS:

We note in you issue of March 25 an item of bridge failure at Lathrop, on the Des Moines & Osceola Narrow Gauge Railroad.

Can you give a subscriber the *cause of failure*, the *style of truss* which gave way, and the name of builders?

Would it not be well to state the first two items in all your notices of bridge failures, as a matter of general useful information?

Respectfully, ALFRED W. BURRELL.

[We publish all these news items as we get them from exchanges or correspondents. Causes of bridge failures are usually too indeterminate to be given at once. The names of builders are not usually given. For railroad bridges the railroad company is usually held as the responsible party. The style of truss is seldom described, and there is but little chance to get particulars of the failures at the time when they occur and can be better determined, and after that there is still less chance. —ED. ENG. NEWS.]

PRICES OF LABOR.

NORTHERN PACIFIC RAILROAD CO.,
Rocky Mountain Division.
Engineer's Office, Bozeman, Mont.

BOZEMAN PASS TUNNEL, April 6, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: Having seen nothing in ENGINEERING NEWS concerning wages and prices of material in this vicinity, I send you the following:

	Per day.
Wages of carpenters	$4.00@$5.00
" " bricklayers	6.00@ 8.00
" " stone masons	5.00@ 6.00
" " common laborers	2.50@ 3.00
" " common laborers, per month	35.00@50.00

Men are in demand in all the above occupations.

Prices of Material.

		In Bozeman.
Brick,	per 1,000	$10.00
Stone,	" perch	2.25
Lumber,	" 1,000	25.00@$30.00
Coal,	" ton	7.00@ 8.00
Wood,	" cord	5.00

and nothing but pine or fir in market.

Yours, truly, E. H. BECHLER,
Asst. Engineer N. P. R. R.

SPIRAL CURVES.

T. I. O. R. R., JALTIPAN, Mexico,
March 31, 1882.

EDITOR ENGINEERING NEWS:

SIR: On page 78, in your issue March 11, please correct the following error:

Formula (VIII.) should be

$$R-R = \frac{l}{3\,n^2}\,(2\,n-1)\,(n-1)\,\sin.\,\varphi_n.$$

Yours truly. W. H. FRY.

BRIDGE AND TUNNEL STATISTICS.

SOUTH PENNSYLVANIA RAILROAD,
BEDFORD, Pa., April 17, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: Will you be kind enough to tell through the columns of ENGINEERING NEWS, where I can find, in cheap form, statistics of bridges and tunnels built in this and other countries, together with description and cost of such works, and oblige SUBSCRIBER.

[We do not know of any work on the subject, but possibly some subscriber does; if so, we will be pleased to hear from him.—ED. ENG. NEWS.]

RECENT INVENTIONS.

SIGNAL FLAG.

A novel signal-flag holder consists of a cylindrical hollow rod provided with a slot in each end. The ends of the rod are each provided with a roller around which the flags are rolled. The rollers have each a head or projection at the ends of the rod by means of which the flag can be wrapped around the roller when desired and thus drawn in.

STREET PAVEMENT.

This improvement consists principally of a foundation for street pavements. It contemplates placing planks arched transversely across the street, and connected by longitudinal wooden strips secured at intervals across said planks in a direction parallel with the sides of the street, and a top covering of earth. A layer of broken stones or shells is placed above the earth, over which is a top dressing of fine gravel.

HEATING STREET-CARS.

The stove is located in the bottom of the car under the seats between the wheels. The heating dome is provided with flanges supported by the bottom of the car, and has a device which is attached to a smoke pipe or flue running along under the seats, and up through the roof of the car in a corner. The fire-box is detachably connected with the bottom portion of the heating-dome, and is provided with a grate and inclined feeding chute, whereby the fuel is supplied, and the fire regulated from the outside of the car.

BALANCING SLIDE-VALVES OF STEAM ENGINES.

This novel method of balancing and lubricating a slide-valve consists in exposing the face of the valve to the action of the pressure of lubricating material, which is contained under pressure in a reservoir or supply vessel seperate from the boiler or source of supply of the motive agent which acts upon the back of the valve. The construction of this engine comprises a cylinder and a slide-valve having a cavity between the valve face and seat. A pipe is provided for supplying a lubricant under pressure to said cavity from a reservoir distinct and separate from the boiler. A throttle-valve is provided for controlling the admission of steam to the valve-chest, and a valve for controlling the admission of the lubricant to said cavity. A device is employed to connect the two valves so that they can be operated simultaneously.

FIRE-BOX FOR LOCOMOTIVES.

The draft of the furnace is downwardly. It employs a tubular water-grate, composed of two or more lines of transverse tubular-bars. A water-space, which forms the bottom of the ash-pit, is used. This water-space communicates with the boiler. A pendent partition forms the front wall of the fuel chamber, and projects below the grate, and causes the flame and products of combustion to infringe on the water-space.

METHOD OF MEASURING HEAT SUPPLIED BY STEAM.

A late and novel process for determining the amount of heat imparted by steam in a steam-heating apparatus, consists in measuring or weighing the water condensed in the apparatus, and therefrom estimating the correlative amount of heat due to the condensation, reference being had to the pressure or temperature at which the steam is supplied to the apparatus. The successive steps are as follows: First, supplying the steam at a known pressure or temperature to the steam-heating apparatus; second, condensing the steam within the apparatus; and, third, measuring or weighing the condensed water as a basis of estimate in calculating the quantity of heat supplied.

NOVEL VALVE-GEAR.

This device consists of a driving-shaft and an eccentric that drives the valve-rod. The eccentric is provided with an elongated slot, through which the shaft passes. Two weights are arranged upon the opposite sides of the driving shaft and appliances to connect either one of said weights to the eccentric, whereby the varying centrifugal force of the shaft through the medium of the connected weight is made to move the eccentric into position to lengthen or shorten the travel of the valve, whatever may be the direction of rotation of the driving-shaft.

IMPROVED MINING PUMP.

This pump has a telescopic extensible section which carries a valve, and, at its lower end, a conical strainer of greater diameter than the section, so that whether the pump is elevated or lowered, the distance between the valve and strainer is uniform. The strainer is made conical and larger than the said telescopic section so as to obtain a large straining area, with perforations at an angle to allow of the escape of débris. Inside the telescopic section is a working-barrel provided with a reciprocating rod and bucket-valve.

WASHINGTON, D. C. F. B. BROCK.

◆

MEXICAN AFFAIRS.

From the New York *World* of the 18th we take the following items communicated by its Mexican correspondent:

At 6 o'clock P. M. on the 1st inst. a salvo of twenty-one guns announced to the denizens of this capital—a city that now prefers the sound of the locomotive to the roar of cannon, which has so often been the signal of fratricidal massacre—that the Federal Congress was about to be formally opened by the President.

I hope to be able to translate the Executive's message in extenso to-morrow, but for the moment can only quote what he said with regard to American railroads, which was literally as follows:

> While the republic has been enjoying uninterrupted peace the material improvements which are under the direction of the Department of Public Works have been continually developing throughout the limits of the republic.
>
> The railroads now in process of construction throughout our country are so numerous that it would be tedious to mention them, therefore I now limit my observations to those roads which are the most important.
>
> The Mexican Central Railroad Company has now in full operation the line from this city to Queretaro, and it is confidently expected that the line will reach Leon long before the time stipulated by the concession has expired. The realization of this expectation will place the center of the republic in communication with its chief sea-port, Vera Cruz. It is probable that by September next the section from Paso del Norte to Chihuahua will be finished, and that the line from Tampico to San Louis will be quite advanced.
>
> The Sonora Railway Company has completed the line from the port of Guaymas to the city of Hermosillo. There are now 195 kilometers of this road ready for traffic.
>
> The Mexican National Construction Company is pushing forward its works on the Toluka Division actively, and has opened to public traffic the section of road from New Laredo to Rio Salado. In addition to this it has also completed seven kilometers on the Matamoras and Monterey Division, twenty kilometers on the line from Zacatecas to San Luis and four kilometers on the extension of the El Salto line towards Maravatio. The latter are concessions which the Mexican National Construction Company has acquired by transfer from the original grantees.

These words, carrying as they do the weight of the utterance of the Chief Magistrate of the country, show clearly and without exaggeration the progress American railway enterprises are making in this republic.

Excepting the Anglo-Mexican line, which is entirely under English control and runs from Vera Cruz to this city, Mexico is a field entirely new to railroad enterprises. It is therefore not strange that American companies encounter numerous difficulties which can only be surmounted by tact and cool judgment.

The Central Railroad is pushing its works forward rapidly, but in its favor we must note that the line passes from this city to the heart of the republic, over districts which present no engineering difficulties whatever; it is like building over our great Western prairies. On the other hand, the Mexican National Construction Company has had to encounter (only five miles from this capital) perhaps the greatest obstacles of any road ever built; every thirty yards show a bridge or a deep cut, or perhaps an immense filling, and every half mile has at least two curves—such curves as only a narrow-gauge line amidst mountain gorges could carry. The views along this portion of the route are extremely picturesque, yet make timid travelers tremble when they see on one side the immense heights of the mountain ranges above them and on the other the great depths of the gorges below. It is an unquestioned fact that the two main lines of railroad in Mexico are the Central and the National, i. e., "the Symon-Nickerson" and the "Palmer-Sullivan." The latter traverses the richest states of the republic—the producing fields of Mexico—while the former touches the populous cities. However, investments in both lines will be remunerative.

Other projected railways may or may not be built, and if constructed may or may not "pay," as we say at home, but disinterested and competent judges who know this country thoroughly affirm that "the Central and National (Symon-Nickerson and Palmer-Sullivan) will pay from the start."

The completion of these two roads will result in substantial profits for the shareholders and also in securing great markets for the northern republic.

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SEWERAGE OF EUROPEAN CITIES.

(Continued from page 124.)

PART IV.—VIENNA.

Ventilation.

Ventilation is had by open grates in the man-holes and partially through soil and rainwater pipes of houses.

Odor in the old sewers, particularly those built of rough masonry, is very strong at all times. The odor in the new brick sewers, and especially in the concrete sewers, is, on the other hand, very slight.

Man and Lamp Holes, Flushing Shafts.

Man-holes are usually 2 ft. square in section, 63 × 63 centimeters, increasing in size towards the bottom, if very deep. They are placed at intervals of about 200 ft. apart, and are all ventilating. Usually they are built directly over the sewers, but in very frequented streets they have side entrances from the sidewalks. The grating has holes 2 in. square by 3 in. to 4 in. deep, with one-half in. of metal between. The iron stepping-rods are placed across the corners.

Gullies.

The gullies vary in design with the inlet. They are sometimes vertical, in the curb (Paris), with an opening 4 in. by 12 in., and sometimes horizontal, in the gutters, and covered with a grating. Many gullies are supplied with catch-basins, especially in the suburbs, and they are rarely trapped.

The gullies are placed in the block, not at street corners. The curbs are 12 in to 14 in. broad, and their height above the gutter is generally 3 in. to 4 in.

Materials and construction.

Sewers are built of bricks and concrete. Pipes are also to be used in future.

Bricks are of the best and are ordinary and wedge-shaped. In the arches both kinds are used in alternating courses. Dimensions of the Austrian bricks are $11\frac{1}{2} \times 5\frac{1}{2} \times 2\frac{1}{2}$ in. The brickwork is built of concentric rings, between which is a heavy coating of cement to render the work water-tight.

Concrete sewers are built in preference whenever the cost is not too great. The centers are made of planed cast iron, which gives the sewers a great degree of smoothness. The best Portland cement is used, in the proportion of 1 to 2 of sand and 5 of stone. Cement is carefully tested for every work.

Statistics

	Yards.
Length of main sewers	50,308
Length of ordinary sewers	191,863
Length of house branches	420,800
	661,041

Or, 387 miles.

IN HOUSES.

Cess-pools are being abolished and water-closets introduced.

House branches (passage-ways, as in Paris) are built from the sewer to the house. They are 6 ft. to 3 ft. 3 in. high and 2 ft. wide. The excrements and the house water are turned into them, but on account of the slight fall they deposit and must be drawn into the sewer with a scraping tool. It is urged at present to substitute vitrified pipes for houses branches.

Up to 1867 they were cleaned at the owner's expense; since, they are cleaned by the city. The length of these brick passage-ways is 245.4 miles.

Number of cess-pools still remaining	536
Number of buildings connected with sewers	10,100

DISPOSAL OF SEWAGE.

The solid matter that is taken from the house branches and sewers, also the contents of cess-pools, are filled into barrels and carted to the "canal," where they are placed on lighters and towed to its junction with the Danube and there discharged into the current.

Sometimes small quantities are sold, for a trifle, as manure.

The sewage discharges into the canal.

At low water its pollution is estimated at one part sewage to 3,500 parts river water. Ordinarily it is one part sewage to 5,800 parts river water. Interception and discharge into the Danube is contemplated.

MAINTENANCE OF SEWERAGE WORKS.

Appliances.

The contents of cess pools and the cleanings from the sewers are removed in casks of wood, strongly built and provided with tightly fitting covers. These are again removed on boats or scows specially constructed for the purpose. Both casks and boats belong to the city. Besides, ordinary scraping and loading tools are used for cleaning the sewers.

Method.

The house-passages or drains are cleaned by the city, as well as the sewers, the whole of which is done under one contract. The inspection is very thorough. The cleaning is done at certain fixed periods. House passages are scraped out once a month, cess-pools are emptied when they are three-quarters full. Sewers are cleaned at intervals varying with their grade. Those with a fall of less than 5 ft. per 1,000 are cleaned once a month, those with 5 to 10 ft. per 1,000 every two months, all over 10 ft. per 1,000 every three months. When deposits reach a greater depth than 8 in., a special cleaning at intermediate times is required.

Besides this regular cleaning, special cleaning may be done on private complaints. The inspectors must walk through the sewers of their districts and examine them after each cleaning and report condition. Full records are kept of this work both for sewers and houses.

The cleaning is done at night between ten and five o'clock, in winter to six o'clock, and its extent is daily reported.

All filth, rubbish, etc., is loaded into casks and carted to the canal, where it is placed upon boats, towed to the Danube, and there discharged. In the winter it is carted to the Danube and discharged opposite the city. The casks must be quite filled and the empty ones returned in a clean condition. The cess-pools are emptied by pumping the contents into casks. After the cleaning of house-passages, they are slightly flushed with water. Sewers have no flushing arrangements, such as pen-stocks, movable dams, etc., although they are contemplated for the future. The contractors for maintaining the sewers have also to free the outfalls in the Wien River or canal from objectionable accumulations.

In 1879 there was a length of 820 miles of sewers cleaned.

COST OF SEWERAGE WORKS.

Management and maintenance.

Annual cost of cleaning sewers	$42,475
Annual cost of cleaning house-drains and cess-pools.	63,700
Annual cost of repairing sewers (owing to many being old and dilapidated)	20,000
	$126,175

The payments for new sewers are divided, so that property-owners bear one-third, *i. e.*, one-sixth on each side of street, and the city two-thirds of the expense.

The payments for cleaning house-drains, passage and cess-pools are made by the city, but the amount is reimbursed by owners in proportion to assessed value of property.

Construction.

Cost of sewers up to 1880, about $4,000,000

Engineering News.

GEO. H. FROST.............. Proprietor.
Tribune Building, New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, Editor.
S. D. V. BURR.......... .... Associate Editor.

SATURDAY, APRIL 22, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to Geo. H. Frost.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6 50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

American Society of Civil Engineers.—Annual Convention, Washington, D. C., May 16, 1882.—The Annual Convention of the Society for the year 1882 will be held at Washington, beginning Tuesday, May 16, 1882. Sessions for professional discussion and one for the transaction of business will be held. At one of the sessions, the annual address will be delivered by the President, Mr. Ashbel Welch.

The general arrangements for the Convention are now in preparation, and will be announced. Details of the programme are in charge of the local committee at Washington, the chairman of which is Col. Thos. Lincoln Casey, Corps of Engineers, U. S. A., Director Am. Soc. C. E.

The families of members are invited to accompany them.

THE UNION LEAGUE AND THE NEW YORK CITY WATER SUPPLY.

It is known that the chief engineer, Isaac Newton, of the Croton Aqueduct Department, has been engaged for the year past in making surveys and estimates for a much needed new aqueduct to carry the waters of the Croton basin to the city, the present aqueduct being already taxed to its utmost capacity, and far beyond what it was designed to meet when constructed, and exhibiting evidence of weakness which renders its entire failure a possibility likely at any moment to arise.

It is well known also, that while the average yield of water from the Croton basin, which passes over the Croton dam, in a series of years, will amount to nearly 300 millions of gallons daily, that fact alone cannot be taken as reliable evidence that for one hundred days in the summer months the supply from the water-shed of the basin will equal one-fifth of the daily needs of the city—in fact, the flow of the river has repeatedly been much below this figure, and the principle of establishing storage reservoirs, whereby the excess of rains during the wet months shall be stored for use during the dry months, is the only expedient whereby the daily average supply from the water-shed shall be available for the city's use. It is estimated that with a storage capacity of 50,000 million gallons, the Croton basin may be relied upon to yield 250 million gallons daily in any season of any year. Accordingly, the sites for several of these reservoirs have been determined and constructed, and a storage of some 12,000 millions is now had, at a cost of about $200 per million gallons stored.

In prosecuting the surveys for a new aqueduct, Mr. Newton found that by erecting a high dam below the present Croton dam, an amount of water could be stored by the dam itself, which taken in connection with the storage reservoirs already provided for, would command for the city the requisite storage capacity to insure the average daily yield of the basin, or 250 millions of gallons daily, without further expenditure for storage reservoirs and at a saving in cost in the latter item of at least two millions of dollars. Accordingly he recommended this location for the new aqueduct, and prepared plans and estimates in detail, and in a Report to the Commissioners of Public Works of date January 30, 1882, stated at length the distinctive features of the work, and the advantages to be anticipated from this location of the aqueduct, the cost of which, on a liberal basis, was estimated at $14,000,000. That the opinion of the entire feasibility of the proposed plan should not rest upon his own individual professional judgment, he laid the plans before John B. Jervis, the engineer who constructed the present Croton aqueduct and who would not naturally be disposed to favor plans so radically different from those which he had himself successfully completed as far back as 1842, unless under conviction of their entire applicability to the growing needs of the city; and James B. Francis, of Massachusetts, a well-known hydraulic engineer of great eminence, and E. S. Chesbrough, an engineer of large experience, lately of Chicago; and Mr. Martin, of Baltimore, who has just completed the Gun Powder water supply for Baltimore, which in its main feature of a continuous rock tunnel, is of the same dimensions and character as the one here proposed. All these gentlemen visited the site of the proposed high dam and other works, and their unqualified approval of the project is appended to Mr. Newton's report. This report was accepted by the Commissioner of Public Works, and forms the basis of his report to the Mayor of the city, and in accordance with its terms, application has been made to the present Legislature for authority to carry out the much needed improvement. The necessity of a new aqueduct at as early a day as possible, is so generally conceded, that its discussion here is unnecessary. What form, dimensions and characteristics it should possess, may well be left to the unbiased opinion of the eminent and experienced professional gentlemen whom we have named above.

When authority was asked of a previous Legislature to construct a new aqueduct, it was met by an adverse petition from the Union League Club of this city—with what success we are unable to state, but after the passage of the bill by the Legislature, it was vetoed by Gov. Cornell. This same club have just issued what is called "A Report of the Committee of Political Reform," and after unqualifiedly condemning the plans of these engineers as "unparalleled and highly dangerous," ask the Legislature to authorize the appointment by the Governor of five commissioners "to decide upon and construct the necessary works"!

The Union League Club is believed to be composed largely of highly respectable individuals—representatives of all the professions and lines of business and some of the trades—the latter, however, not in practice at present. Membership is supposed to give one a quasi social position, especially if the individual possesses a certain amount of wealth, or family influence or unexceptionable associations. Some of its members have cultivation—some have not—some are wise and some are otherwise—but with all the varying accomplishments attributed to many of its individual members, the Club never has taken rank as an aggregation of scientists, nor ever assumed that a majority of its members, nor even a respectable minority, were such. Indeed, we believe, that such of its members as possess that rarest of human endowments, common sense, would disavow any such pretensions; and yet we find the Club has allowed itself to be committed to a line of criticism on a matter of pure engineering science, which nothing but the possession of the highest professional talent would justify. If, happily, the membership of the Club embraces a few professionally educated engineers, which is probable, they would not be found likely to put themselves on record as calling in question the soundness of the judgment of the men who have approved the project of the high dam. What shall we say, then, of the modesty of the gentlemen of this Club in presuming to put their crude notions before the public in antagonism with the professional judgment of men who have made the subject-matter the study and practice of their long lives? The Club would have the Governor appoint five commissioners to plan and construct the needed works. The question at issue is a purely engineering one, and of which none but professional men of extensive experience are qualified to judge. Admitting this to be the fact, and it is too patent to be denied, where, within the bounds of the State, can five men be found whose judgment on a professional question the public would accept as a safer guide than that of the five men whose opinions the Club have voted upon as not entitled to credit?

We might leave this petition of the Union League for the practical common sense of public men to deal with as its merits may justify, but cannot forbear exhibiting briefly a few of its crudities, and the weakness of its general line of argument.

On page 21 of Mr. Newton's report will be found a comparative statement of the three lines which have been proposed for the new aqueduct, viz., Bronx River plan of 1875, Saw Mill River plan, also of 1875, and the Quaker bridge line of 1881; the latter the one which he recommends. The aggregate cost of these several lines, under varying conditions, are given; the items in detail, with their estimated cost, which would needlessly encumber the report, are very properly omitted as of no general interest, and no subject for public discussion, but reference is made to these details as open to inspection. The length of the proposed high dam at the water line, is 1,300 ft. instead of 3,000 as stated in the "petition." The site of the dam has a rock foundation, sides and bottom, as might be anticipated from the geological formation, and which test borings have confirmed. The dam is to be built of solid cemented masonry, without opening of any kind whatever, the flood discharge to be otherwise provided for. Neither the high dam at the St. Chamond, nor the one on the Furens 164 feet in height, nor any other high dam is cited by Mr. Newton as "precedents" for the Quaker bridge dam, as is stated by petitioners, further than, as he distinctly says, that "they fully confirm the theories" advanced by certain distinguished engineers of the corps of ponts et chausées and Prof. Rankine, of England, who have ably discussed the subject of high dams, and established the "principles" upon which they should be designed. The "petitioners" remark that "This is an extraordinary statement to be made by an engineer," and proceed to say that the dam at St. Chamond was but 138 ft. high! and Prof. Rankine never built a high dam, leaving the dam at the Furens of 164 ft. in height as "the only precedent" for a high dam. It should be observed, that the word "precedent," which is used so freely in the petition, does not once occur in Mr. Newton's report; nor does the fact that the St. Chamond dam was but 138 ft. in height, nor that Rankine was not a constructing engineer, at all vitiate the "principles" which these savans have established as properly governing the design of high masonry dams, and which the successful construction of one of so slight an elevation as 164 ft. confirms the accuracy of as well as would one of 200 ft. If, disregarding scientific principles, we had waited for a literal precedent in feet and inches before attempting great works, when would the boasted improvements of the present day have appeared? If the petitioners had known more of the subject which they presume to criticise, they would have found that the "principles" now established for the design of high dams embrace a distinct profile, whereby the weight of the structure, per unit of area in its foundation, can be kept within the safe limit of the resisting strength of the materials composing it; and, in conformity therewith, the proposed Quaker bridge dam, 200 ft. in height above the river on the existing rock bottom which is found there, can be built of such dimensions and profile as to present a strength of resistance to sliding on its base, or overturning or sliding at any section of its profile, or to any of the dangers to which dams heretofore have been exposed, far in excess of the pressure from 180 ft. of water under any conceivable circumstances, and this, not by "being tied to the solid rock at its base and sides as in a vice," as the petitioners in their ignorance allege to be necessary, but by the simple gravity of its mass admitting of ready estimation, and which is the sole sustaining power that can be relied upon for the stability of any great dam.

There is not a single argument presented by the petitioners entitled to any weight whatever beyond that due to the prestige of the Union League Club, whatever that may be; and as waters cannot rise above their source we need not look in that direction for able discussions of great engineering problems; but we object to attempting to cover a political animus by making a false issue, and that one involving high scientific principles.

With the political aspect of the question we have nothing to do, but a single further quotation will amply illustrate, we think, that the engineering question is entirely a secondary one, and is merely a make-weight in the argument that would have been offered were the sentiments of the community sufficiently in accord with some of the "would-be" influential members of the club.

The petitioners go on to say "that not a fact is presented in these extracts (Mr. Newton's report) upon which any prudent man would expend a single dollar in the construction of the work."

In answer to this we quote from Mr. J. B. Jervis' report, embraced in Mr. Newton's, as follows: "As to the propriety of a second aqueduct, there can be no doubt. The dam you propose is practicable. That it is the *best, and, in fact, the only plan* that can secure the whole source of the Croton Valley for the supply of its waters to the city of New York. As to the line and plan of aqueduct you propose, I see nothing to suggest. Your view of this I regard as well taken. With sincere wishes for your success in the construction of this rather bold, but eminently important, and, as I believe, quite practical work, I submit this paper."

One would suppose in view of Mr. Jervis' well-known conservatism that any member of the League might safely regard this as a sufficient basis for the expenditure of such proportion of the public money as is derived from his individual tax. And the moving spirits of the petition, well aware that the public would so regard it, and such an opinion, delivered by such a man, would outweigh their feeble opposition, introduce in their petition, as if an important fact in the history of the first aqueduct, a statement that the Croton dam, as located and built by Mr. Jervis, was carried away by a flood in the winter of 1841, the intention clearly being to leave the impression that it was possible Mr. Jervis might approve of the plan of a dam, and, in fact, build one on this very stream which would in truth ultimately prove a miserable failure.

If such was the intention of the petitioners, they have proved a little too much. If Mr. Jervis in earlier times built a dam on the Croton, which a flood swept away, he would be the last man, with his additional forty years of experience, to risk his world-wide reputation by favoring the construction of a second dam liable under any contingency that the mind of man could foresee to the same catastrophe. If there be a man in the wide world who has a respectful opinion of the Croton in an angry flow, that man is John B. Jervis, and it would be as becoming, as safe, for any member of the Union League Club of New York to accept his views on the question of what constituted a proper dam on the Croton River, even if they were unable to understand them.

SUSPENSION BRIDGES.

The last three numbers of the journal of the Franklin Institute contain a paper by Prof. Du Bois, of the Sheffield Scientific School of Yale College, entitled "A New Theory of the Suspension Sytems with Stiffening Truss." The investigation is conducted with the usual ability of Prof. Du Bois when dealing with problems of this kind; out the question at once arises in our mind, of what value is the highest scientific attainment, by which we mean in this case the ability to represent in a purely mathematical form, the relations existing between stresses and strains upon certain assumptions, where these assumptions themselves admit possibly of question as to their truth or practical value. We are reminded of the worthy analyst, who, upon stating the results of some of his theoretical deductions, was told by the practical man familiar with the facts in the case, that these theoretical deductions were at variance with the facts. "Then," said the theorist, "so much the worse for the facts." The existing theory is stated as follows: [The italics are not ours.] "In a system of cables, truss and stays, the cable is suppose to carry the entire dead and live load. The stays are inserted for additional stiffness at the flanks, while the truss is constructed to merely rest upon the abutments, and it is assumed that it so distributes any partial loading that the curve of the cable remains practically unchanged. That is, the curve of the cable is assumed to be parabolic, as it is assumed that the truss distributes any partial load *so as to make it take effect upon the cable as a uniform load*, thus preserving the parbolic shape."

In opposition to this generally received theory, as stated by Du Bois, he maintains "that the curve of the cable does *not* remain parabolic, but takes the curve of equilibrium due to the loading." He also discards stays entirely, "upon the ground that they are unnecessary;" "the strains rendered thereby impossible of accurate adjustment; their introduction a confession of imperfect design; and if the material in them were put into the truss there would be a positive gain of rigidity." Please observe the constant recurrence of the word *rigidity*, previously and in the quotation which follows: "As to the truss, while it has been recognized that it is the main element of rigidity, owing to false ideas of economy and a superstitious dread of 'temperature strains,' the very rigidity which is sought to be secured by its use is often sacrificed by the introduction of hinges, or, at most, being allowed to rest upon the masonry. There seems no defense for such practice. As stiffness is what we wish let us take the best means to secure it. The girder fastened down horizontally at both ends is the stiffest construction we can employ. As to temperature strains in general they can be easily calculated and found not to be excessive, and it is far better to allow for them by proper cross-sections than to sacrifice rigidity in order to avoid them and then to insert all the material apparently saved in the shape of stays."

The object of all theoretical investigation, with its attendant mathematical exhibition, is not an end in itself, further than it is susceptible of translation into rules for practical application. On page 250 our author comes out, after a most bewildering display (to any but a professed mathematician] of differentiation and integration, with two equations and three unknown quantities, and then says: "It is necessary to find a third equation. This we can easily do by assuming in accordance with the ordinary theory that the curve of the cable remains parabolic even for partial loading. Although the assumption is not theoretically correct, still, *in practice* [italics ours], the real curve differs so little from the parabolic, that, so far as the cable alone is concerned, the value of H thus found is very exactly the real value of H;" H, we presume, being the horizontal component of the tension of the cables.

If this recourse to an incorrect theory is essential to a practical result, it would appear that the objections to it in the first place are more fictitious than real. However, this matter is less important than the opposition to stays, which the Professor condemns as unnecessary and indicative of faulty design, etc.

In numerous papers by John A. Roebling, he takes occasion to urge the great importance of stays, and in a paper by him now before us, he bears witness to their prime importance in the Cincinnati bridge of 1,000 ft. central span. "The larger and heavier the span, the greater will be its comparative stability at the center. Vertical stability to the center is also insured in large spans by the weight of the structures. But not so between the center and the towers. In consequence of the equilibrating tendency of the two opposite halves, vertical oscillations occur easier, and the great length of suspenders, acting like pendulums, promote lateral displacements. These tendencies have to be met and are thoroughly overcome in the Ohio bridge by an effective system of stays. Their arrangement in this bridge not only insures their freedom from oscillation, but renders them fully effective by the uninterrupted preservation of their lines. The stays render another and very important service by effectually insuring an equilibrium between the main half spans. Without stays the balance between adjoining spans would at times be disturbed by unequal loading," and he subsequently meets the objection that the stays will not act in unison with the cables by a satisfactory explanation. If the successful construction of long suspension bridges entitles an engineer to an opinion upon the merits of different systems offered for his choice, then we say that, to this day, no engineer has approached Mr. Roebling in his knowledge of the action of this form of bridge, and so far from aiming at rigidity in his structures, he especially deprecates the attempt at rigidity, and claims for the suspension bridges of his design, a *flexibility* which he considers an element of safety, and that this flexibility may be under control in its amplitude, he considered the stays as a most important element in long suspension bridges in connection with trusses; and he says, "that to attempt a degree of rigidity equal to a tube would be a step in the wrong direction of *positive injury*."

If the theory of suspension bridges as adopted by Mr. Roebling is faulty, as the mathematics which have been pressed into the service is supposed to indicate, we have some marvelous structures in our midst, which bid fair to live down all caviling as to the practical merits of their design.

LAKE GEORGE WATER SUPPLY.

The distinctive feature of this enterprise has been lost in the Committee of the Legislature to which the bill was referred, by striking out the Lake George reservoir, which was the original idea from whence the scheme took its bill and name. The opposition to the bill has sensibly decreased since this change in the programme was effected, and we are assured that from the statements of Mr. Verplanck Colvin, who for many years past has had charge of the State surveys in the Adirondack region, and familiar with its resources, that Lake Schroon and many large bodies of water offer great facilities for the construction of dams, and equal storage capacity with Lake George, and at a greatly reduced cost for riparian rights, so that no difficulty will be experienced in securing a body of water sufficient to maintain the normal flow of the Hudson River at the low stage above Troy, and at the same time furnish all that was contemplated in the original bill for the supply of the cities in the valley of the Hudson, including New York City and Brooklyn.

PERSONAL.

JOHN SCHUYLER has been chosen chief engineer of the Central Underground Railroad of New York.

EDWIN TURNER, of Zanesville, O., has been appointed Chief Engineer of the Bellaire, Zanesville & Cincinnati Railroad.

JAMES L. RANDOLPH, of Baltimore, has been appointed chief engineer of the Baltimore & Ohio and Chicago Railroad.

MARVIN PORTER has been appointed Chief Engineer of the Fayetteville & Winston Railroad. Headquarters at High Point, N. C.

CHARLES HARLEY has been appointed chief engineer of the Fort Madison & Northwestern Railroad in place of Charles A. Gilchrist, resigned.

THOMAS L. BUTLER, age 50, died on the 17th at his house, No. 154 East Forty-seventh street. He was a well-known contractor, a brother of County Clerk Butler, and brother-in-law of George Caulfield, Commissioner of Jurors.

MICHAEL SHANLEY, a widely known railroad contractor, died at his house, No. 36 Central avenue, Newark, on the 17th, of neuralgia of the heart. Mr. Shanley was born in County Roscommon, Ireland, fifty-nine years ago. His parents died while he was a boy, and he started alone to America. He learned the hatting trade and settled in Newark at the time of his marriage in 1857. He gradually obtained the bulk of the city and railroad contract work in New Jersey. One of his most important contracts was the cut through Bergen Hill, begun four years ago, and which is not yet finished. He ballasted the Pennsylvania Railroad from New York to Pittsburgh, Penna. A great part of the street and sewer systems of Newark was constructed by Mr. Shanley, who also laid both of the large water mains for the Aqueduct Board of that city. Last January he gave up business to his two sons, and retired with a fortune of about a quarter of a million of dollars. The funeral services will take place on Wednesday, at 9.30 a. m., in St. Patrick's Cathedral, Newark.

HENRI GIFFARD.—A dispatch from Paris announces the death of Henri Giffard, a French engineer. He was born in 1825, and at the age of 16 entered the draughtsman's room of one of the Parisian railway offices. Two years later he became enthusiastic on the subject of aerial navigation, and, in 1852, made an ascent in a balloon in which a steam engine had been placed. The attempt attracted much attention at the time, and Giffard published in *La Presse* an interesting account of his voyage. During the Universal Exposition at Paris, in 1867, he arranged a number of ascensions in a captive baloon from the Champ de Mars, and during the Exposition in 1878, he managed similar ascensions in a monster balloon from the gardens of the Tuileries. In both instances the balloons possessed original features of construction, and the ascensions formed the subject of much public interest. The monster balloon was eventually sold to the Godard brothers, and was subsequently destroyed in a tempest in 1879. M. Giffard invented several very useful improvements in the machinery of railway engines, which are to-day in general use. His prominence as an inventor obtained for him in 1863 the decoration of the Legion of Honor.

OBITUARY.

CHAS. ROBERT DARWIN.

The announcement that Charles Robert Darwin died on Wednesday at his residence, Down House, near Orpington, will be read by very few individuals who have not some degree of acquaintance with the physical theories formulated and taught by this distinguished naturalist, however scanty may be their actual knowledge of his work. Darwin has been read much, but talked about more. Since the publication of his work "On the Origin of Species" in 1859, and particularly within the 11 years which have elapsed since his "Descent of Man" was given to the world, he has been the most widely known of living thinkers. Doctrines such as he set forth could not long remain the exclusive property of philosophers nor of educated people. They made their way at once into the reading and thought of the masses, until the slightest allusion to Darwinism was sure of instant recognition from even the most illiterate individual or audiance. It is not to be supposed that every country clergyman, with a library not extending far beyond Richard Baxter, Jortin, Bishop Barkeley, and a commentary or two, became profoundly versed in the doctrines of evolution, or that little laughing school-girls joking each other about a monkey ancestry had followed Mr. Darwin very far in his speculations on differentiation of species, but the ministers somehow all knew that evolution was an abominable heresy to be by precept and example thrust out of men's minds, and the school children intuitively understood that if man is descended from the ape he cannot be descended from Adam. All that part of the world which had never thought of such things before was aroused by the shock of a new idea. Previous speculations upon the origin of man had, it is safe to say, been the diversion of the learned; the people at large had no part in them. But here was a scientist, not a speculative philosopher, who dealt with facts and logical inferences in a new way, and he speedily had the whole world for an audience. Everybody saw that the history of living forms as his books taught it was widely at variance with the Mosaic account of the creation, and from the moment when the Darwinian theory of evolution was publicly stated the modern struggle between science and theological dogma took its rise. There had been skeptics and atheists and deists and what not before, but what grave essayists call scientific unbelief sprang primarily from works of Charles Darwin, and is fed chiefly from the writings of other scientists who are at work extending and completing the frame-work he erected. Mr. Darwin, therefore, may be called an epoch-making man.

The qualities and natural bent of his clear mind were inherited. His father and grandfather were naturalists, though the latter, Dr. Erasmus Darwin, was a much more famous and productive man than his son, Dr. R. W. Darwin. Erasmus Darwin, a botanist of renown, is best known as the author of a remarkable poem called the "Botanic Garden," which, though destitute of the poetic feeling, shows its author to have been deeply versed in the Linnæan system of botany. Of Dr. R. W. Darwin little is known save that he was a member of the Royal Society. Charles Robert Darwin was born at Shrewsbury, England, Feb. 12, 1809. His early education was received in the Shrewsbury Grammar School, under the tuition of Dr. Butler. In 1825, when he was 16 years old, he entered Edinburgh University, and remained there two years, going then to Christ's College, Cambridge, where he received the degree of Bachelor of Arts in 1831. In December of the same year he was selected as a naturalist to make a voyage of scientific exploration around the world on board the ship Beagle. Five years were spent in this way. We may fairly suppose that Mr. Darwin was a naturalist of some competence and training when he set out on this voyage. The opportunities for research, experiment and study which it gave him, particularly during his stay in South America, were fruitful in the material and hints out of which his later theories were evolved. Indeed, in geographical and geological distribution Mr. Darwin found the weightiest proofs of the truth of his system. Returning from this voyage in 1836, he began the preparation of a "Journal of Researches" into the geology and natural history of the countries visited by the expedition. This was published as a part of Capt. Fitzray's "Narrative of the Surveying Voyages of H. M. S. Beagle and Adventurer." In succeeding years he edited, in five parts, the "Zoology of the Voyage of the Beagle," the notes of the habits and range of mammalia being by his hand. Out of the material obtained on this cruise he prepared for publication, in 1842, "The Structure and Distribution of Coral Reefs;" in 1874, "Geological Observations on Volcanic Islands," and in 1846, "Geological Observations on South America." Between 1844 and 1859 his publications were mostly brief monographs contributed to scientific publications or read before learned societies. But during this long period of slight literary productivity he occupied himself with untiring zeal and systematic regularity in the study of nature, making a series of observations upon the forms and habits of animals, plants and minerals—for it is hard to say whether he was most eminent in zoology, botany or geology—and slowly accumulating that vast mass of facts and registered phenomena to which he was later on to apply his theory of evolution.

The publication in 1859 of his work "On the Origin of Species by Means of Natural Selection; or, the Preservation of Favored Races in the Struggle for Life," was the announcement to his friends that he had at length passed over the sea of hypothesis to the firm ground of scientific assertion, and to the world that it must revise or fortify its opinions on biological subjects. After making in 1862 one of those excursions into the by-ways of scientific inquiry of which he was so fond, of which the outcome was his work on "The Various Contrivances by which Orchids are Fertilized by Insects," and still another in 1865 to publish the well-known book on "The Movements and Habits of Climbing Plants," he put forth in 1868 another important work on "The Variation of Animals and Plants under Domestication," in two volumes. In 1871 appeared the best known of all his books, "The Descent of Man and Selection in Relation to Sex," in two volumes. The following year saw the publication of "The Expression of the Emotions in Man and Animals;" in 1875 appeared "Insectiverous Plants;" in 1876 "The Effects of Cross and Self-fertilization in the Vegetable Kingdom;" in 1877, "The Different Forms of Flowers and Plants of the Same Species," and in 1881 "The Power of Movement in Plants." Each of these books has its place in the development of the theory which bears their author's name. All of them, even those which concern only a single order of the phenomena, abound in illustrations pertinent to his great theme, and supply those who wish to use or investigate his theories with the classified results of his accurate observations. But it is upon the "Origin of Species" and the "Descent of Man," in which the theory of evolution is made to tell the history of life upon the earth, as we now see it, that his fame chiefly rests.

If asked to define Darwinism, the orthodox antagonist of the scientific unbelief of the day will reply that it is an attempt to show how blind matter became the seeing eye; the biologist of the Haeckel school will say that it is a description of the mechanical process by which the cosmic system was produced out of elementary matter acted upon by its own laws. Neither definition is correct, for Mr. Darwin made an extremely modest use of his great attainments. He did not construct a theory of the cosmos, and he did not deal with the entire theory of evolution. He was content to leave others to poke about in the original protoplasmic mire, and to extend the evolutionary law to social and political phenomena. For himself, he tried to show how higher organic forms were evolved out of lower. He starts with life already existing, and traces it through its successives forms up to the highest—man. The central principle—his opponents call it a dogma—of Mr. Darwin's system is "natural selection," called by Herbert Spencer "survival of the fittest," a choice which results inevitably from "the struggle for existence." It is a law and fact in nature that there shall be the weak and the strong. The strong shall triumph and the weak shall go to the wall. The law, though involving destruction, is really preservative. If all plants and animals were free to reproduce their kind under like and equally favorable conditions, if all were equally strong and well equipped for obtaining sustenance and making their way in the world, there would soon be no room on the earth for even a single species. Thirty millions of men in less than 700 years of unchecked reproduction, under the conditions we have mentioned, would have living offspring enough to cover the whole earth at the rate of one for each square foot of its surface. The limit of subsistence and the power of reproduction are the bounds between which the conflict rages. In this struggle the multitudes are slain and the few survive. But the survivors do not owe their good luck to chance. Their adaptation to their surroundings is the secret of their exemption from the fate which overtakes those less happily circumstanced. A variety of squirrels, for instance, which is capable of wandering far afield in pursuit of its food, which is cunning and swift enough to evade its enemies, and has a habit of providing a store of nuts for winter use, will naturally have a better chance of survival than a variety deficient in these qualities. But Mr. Darwin also discovered that natural selection created special fitness for given circumstances and surroundings. Climate, soil, food supply, and other conditions act in this way, and the result is the differentiation of species. A certain thistle grows in a kind of soil which is rich in the elements which go to produce the tiny hairs upon the surface of the plant. The seeds are thus furnished with downy wings longer than usual, and are wafted further off where they have plenty of space to grow, and they, in turn, reproduce and emphasize the changes to which they owe their existence. Seeds or nuts developing a thick covering for the kernel are thus protected from birds and animals, and live to germinate, producing also hard-shelled seeds, and thus the process goes on. Varieties which do not develop a high degree of special adaptation to their surroundings fall out of the race, unable to defend themselves against their innumerable aggressors. An infinitesimally minute variation of function or structure repeated and becoming more marked through many successive generations, results ultimately in the production of a variety, or even of a species, quite unlike the parent individual.

Mr. Darwin was by no means the discoverer of the theory of evolution. That is at least as old as Aristotle, who supposed individuals to be produced, not by a simultaneous creation of a minute copy of the adult, with all the different organs, but by epigenisis—that is, by successive acts of generation or growth, in which the rudiment or cell received additions. Other ancient philosophers, and in more modern times Descartes, Spinoza, Leibnitz, Bonnet, Lamarck and Cuvier, have adopted and used this theory to a greater or less extent. But it never had a substantial basis of fact or a thoroughly scientific application until Mr. Darwin worked it out. Others, as we have said, and notably Mr. Spencer, have given it a more comprehensive scope, but within the limits he set for himself Mr. Darwin meets no rival claimant for the honors the scientific and thinking world have accorded him. The dispatch announcing his death says that he had been suffering for some time from weakness of the heart, but continued to work to the last. He was taken ill on Tuesday night with pains in the chest, faintness and nausea. The nausea lasted more or less during Wednesday, and culminated in death in the afternoon. Mr. Darwin remained fully conscious until within a quarter of an hour of his death.—*New York Times.*

WATER SUPPLY OF WASHINGTON.

The bill recently reported to the Senate, in regard to extending the Potomac water-works, directs the Secretary of War to make a survey and map of the land necessary to extend the aqueduct from its present terminus to the high grounds north of Washington, near Sixth street extended, and of the land necessary for a reservoir of a capacity not less than 300,000,000 gallons, and a like survey and map of the land necessary for a dam across the river at Great Falls, and necessary for the extension of said dam. And when these surveys and maps shall have been completed the Secretary of War and Attorney General shall proceed to acquire titles to the land necessary, either by private contract or by condemnation; and if the land for the extension of the dam shall be acquired by private contract the Secretary of War and the Attorney General are authorized and may, in their discretion, compromise, settle and adjust with the owner or owners of said lands and water rights all questions of damages claimed by said parties by reason of the erection of the present dam and the diversion of water from the channel at that point.

Section 2 authorizes and directs the Secretary of War to extend the Washington aqueduct from its present terminus to the high grounds near Sixth street extended, and to construct at that point a reservoir of not less than 300,000,000 gallons capacity; also to construct the necessary gate-house, and lay such main connections as may be necessary to furnish Washington and Georgetown an adequate supply of water. And so soon as the titles are acquired he shall complete the dam at Great Falls to the level of 148 ft. above tide, and extend it across Conn's Island to the Virginia shore; and to raise the embankment between the Potomac River and canal above the dam, so as to protect the canal from flooding, or pay to the canal company in full satisfaction of such flooding the amount "hereinafter appropriated" (in the bill) for that purpose.

Section 3 appropriates for the work the following sums, or so much thereof as may be necessary: To pay for land to extend aqueduct, $51,370; for extension of aqueduct to Sixth street extended, $599,534.55; for necessary main connections, $165,400; to pay for land for reservoir, $35,250; for work and material in constructing reservoir and gate-house, $431,278.75; to pay for water rights and lands necessary to extend dam at Great Falls, $35,000; to protect the Chesapeake and Ohio Canal from increased flooding by reason of completing the dam, $12,300.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 114.

CCLXXIV.—PETERSBURG.

Petersburg, Virginia, in lat. 37° 13' N., long. 77° 18' W., on the Appomattox River, is on three plateaus rising gradually from the river.

Settled in 1686, it was incorporated as a city in 1850. Water-works were built by the city in 1857, after the plans of Henry D. Bird. The supply is taken from a small brook, which is impounded by a stone dam 40 ft. high, 5 ft. wide on top and 40 ft. at bottom. From this storage reservoir the water is pumped by steam-power 100 ft. into a distributing reservoir, in excavation and embankment, lined with brick and containing 300,000 gallons, at 70 ft. above the upper part of the city. The pump, built by Uriah Wells, of Petersburg, is of 13-in. diameter and 60-in. stroke. There is also a Guild & Garrison pump which is not used. Distribution is by 12 miles of cast-iron pipe of from 12 to 4-in. diameter, with 60 fire hydrants. The number of taps is not given. Wrought-iron service pipes are used. The population in 1880 was 21,656 and the daily consumption 60,000 gallons.

The works have cost $150,000. There is a bonded debt of $125,000 at 8 per cent. interest.

The expenses of maintenance in 1881 were $4,300 and the receipts $8,300. The works are managed by officers appointed by the Common Council.

William Kirkham has been the Superintendent since 1876.

CCLXXV.—SOUTH BETHLEHEM.

South Bethlehem, Pennsylvania, in lat. 40° 36' 24" N., long. 76° 56' 8" W., is on the Lehigh River, on ground sloping gently back from the river to hills on the south and west.

Settled in 1742, it was incorporated in 1866.

Water-works were built by a private company in 1875, after the plans and under the superintendence of B. E. Lehmann, taking the supply from the Lehigh River and pumping by steam-power into the mains. An accumulator is used, the plunger of which is weighted to any desired pressure. The ordinary pressure is from 70 to 95 lbs., and the fire pressure from 90 to 120 lbs.

A Cameron pump, with water cylinder of 12 in. drain and 36-in. stroke was erected in 1875, and another pump added in 1878, built by the Bethlehem Iron Co.

Distribution is by cast-iron pipe of from 8 to 3-in. diameter; 5 miles are in use, with 36 fire hydrants, 36 gates and 300 taps. Two railroad tanks are also supplied. The city pays $15 per year for each fire hydrant. Service pipes are of lead.

The population, 1880, was 5,500. The daily consumption is not given.

The stock of the company is $10,000, and the bonded debt is $18,000, at 7 per cent. interest.

The total cost of the works has been $32,378.45 and the receipts $19,750.61. The expenses in 1880 were $760.30, and the receipts $3,633.76.

H. Stanley Goodwin is Secretary and Treasurer of the company, and B. E. Lahmann the Superintendent.

CCLXXVI.—MARENGO.

Marengo, Iowa, in lat 41° 48' N., long. 92° 5' W., is on the Iowa River.

Water-works, for fire protection only, were built in 1874. A Worthington pump in a mill, ½ mile from the town, is arranged to be thrown into gear with the water-wheel of the mill and pump water from the race through a mile of 6-in. and 4-in. pipe, on which are placed 8 fire hydrants.

The population in 1880 was 2,583.

The works are owned by the city. A. J. Morrison is the Mayor and controls the works.

CCLXXVII.—LITCHFIELD.

Litchfield, Illinois, in lat. 39° 32' N., long. 89 43 W., is on level ground. Settled in 1854, it was incorporated as a city in 1859. Water-works were built by the city in 1873, taking the supply from a pond formed by an earth-dam across Shoal Creek, which drains about 20 square miles. A Holly pump was first used. A Worthington pump of 240,000 gallons capacity was afterwards put in. The water is pumped directly into the mains with an ordinary pressure of 40 lbs. per square inch. About 5 miles of cast-iron distribution pipe, with 35 hydrants and 300 taps.

The population in 1880 was 4,500. The consumption is not given. The works have cost $96,000, and the receipts have been $10,000. There is a bonded debt of $50,000 at 8 per cent. interest, which is not paid, however, owing to litigation. The expenses in 1880 were about $3,500, and the receipts $1,400. The works are managed by the City Council and G. W. Jones, the City Clerk.

CCLXXVIII.—BORDENTOWN.

Bordentown, New Jersey, in lat. 40° 9 N., long. 74° 38 W., is on the Delaware River. The town is on ground elevated about 60 ft. above the river, and was settled early in the last century.

Water-works were built by a private company in 1856, after the plans of James W. Allen, taking the supply from the Delaware River and pumping it by a Worthington compound duplex steam pump, with steam cylinders of 20 and 14-in. diameter, and water cylinder of 10-in. diameter, all of 9-in. stroke, through 5,400 ft. of 6-in. pipe to a reservoir 100 ft. above the river, built in excavation and embankment, and holding 684,466 gallons.

Distribution is by 5 miles of cast-iron pipe of 6-in. and 3-in. diameter, with 39 fire hydrants. The number of taps is not given; 9 meters are in use. The city pays $600 per year for the use of hydrants.

The population in 1880 was 6,008, and the daily consumption 150,000 gallons.

The stock of the company is $30,000. The works cost originally $40,000. No further financial statements are given.

John M. Steele is the Superintendent.

CCLXXIX.—MILFORD, MASS.

Milford, Massachusetts, in lat. 42° 8 N., long. 71° 32' W., is on the Charles River. It is an old town. Water works were built in 1881 by a private company, taking the supply from the river and pumping directly into the mains by a Holly steam pump. The ordinary pressure is 70 lbs., and the fire pressure 150 lbs.

Distribution is by 10 miles of cast-iron pipe, the sizes of which are not given. There are 61 fire hydrants, for which the town pays $2,800 per year. The number of taps is not given. Lead service pipes are used.

The population in 1880 was 9,310.

The stock of the company is $100,000, and the bonded debt $60,000, at 5 per cent. interest.

The works went into operation April 4, 1881.

Moses Joy, Jr., is President, and C. W. Shippee, Secretary.

CCLXXX.—OIL CITY.

Oil City, Pennsylvania, in lat. 41° 25 N., long. 79° 47' W., is on the Allegheny River, in the centre of the oil district. Settled in 1860, it was incorporated as a city in 1871.

Water-works were built by the city in 1872, after plans of H. P. M. Birkenbine, C. E., and under the superintendence of John Birkenbine, C. E. The supply is taken from the Allegheny River through a 16-in. pipe laid out into the channel, and which conveys the water to the pump well, where it is lifted 320 ft. by an Eclipse steam pump with steam cylinder of 24-in. and water cylinder of 12-in. diameter and 30-in. stroke, into a reservoir built in excavation and embankment, containing 3,000,000 gallons, and 310 ft. above the city, giving 120 lbs. pressure in the mains. Distribution is by 12 miles of cast iron pipe of from 12 to 4-in. diameter, with 90 fire hydrants and 66 gates. The number of taps is not given. Three meters are in use. For service pipes lead is used to the curb line and then galvanized iron.

The population in 1880 was 9,644. The consumption is not known.

The works cost $160,000. There is a bonded debt of $93,000, at 8 per cent interest, and falling due in 1882.

No further financial statistics are given.

The works are managed by four Water Commissioners appointed by the City Council.

S. D. Miller is the Superintendent.

CCLXXXI.—RICHFIELD SPRINGS.

Richfield Springs, New York, in lat. 42° 50 N., long. 74° 58 W., is in a hilly country and near the head of Schuyler Lake. Sulphur medicinal springs make it a place of summer resort. Water-works were built by the village in 1879, after the plans of P. H. Baermann, C. E. The supply is taken from a stream among the hills, which is impounded by an earthen dam with puddled heart. A 10-in. earthenware pipe conveys the water half a mile to another reservoir, formed by a concrete dam across a ravine. The storage capacity of the two is 7,000,000 gallons, at 200 ft. above the village. Distribution is by 4 miles of cast-iron pipe, of from 10 to 4-in. diameter, with 18 fire hydrants.

The number of taps is not given.

The population in 1880 was 1,350. The consumption is not stated.

The works cost $24,000. The receipts to 1882 were $2,500. The bonded debt is $23,000, at 6 per cent. interest.

The works are managed by the trustees of the village, of which Guy Kinne is President.

CCLXXXII.—WATERTOWN, N. Y.

Watertown, New York, in lat. 43° 57 N., long. 75° 55 W., is on the Black River, which at this point falls 24 ft. with a succession of rapids below, affording a fine water-power. Settled about 1800, it was incorporated as a city in 1869. Water-works were built in 1858 by the town, taking the supply from the river and pumping it by water-power 150 ft. into a reservoir, by two two-cylinder double-acting horizontal pumps, one of 12-in. bore and 36-in. stroke, the other of 12-in. bore and 42-in stroke. New Worthington pumps, with four cylinders of 18-in. bore and 36-in stroke, have just been erected.

Distribution was at first by wrought-iron and cement pipe. Some of this has stood well and is still in use. Most of it has been replaced by cast-iron pipe, which is now exclusively used. About 16 miles are in use, with 110 fire hydrants. The number of taps is not given.

The city pays $2,500 per year out of taxation for fire protection. Both lead and wrought iron are used for service pipes.

The population in 1880 was 10,697. The consumption is not stated.

The works have cost $200,000. The bonded debt is $700,000, bearing interest at from 4 to 7 per cent. Further financial statements are not given.

The works are managed by five Commissioners, one of whom is elected each year by popular vote. R. Van Namee is the President and A. Salisbury the Superintendent.

CCLXXXIII.—BLAIRSVILLE.

Blairsville, Pennsylvania, in lat. 40° 27 N., long. 79° 18' W., is on the Conemaugh River, at the base of the first bench of the Allegheny Mountains on the west. It was settled early in the last century, and incorporated as a borough in 1825.

Water-works were built in 1872 by the borough, after plans of Robert Neilson, C. E., taking the supply from the Conemaugh River and lifting it 190 ft. by a pump into a circular reservoir 60 ft. in diameter, and holding 200,000 gallons, built of stone masonry, and situated about 112 ft. above the highest part of the town.

Distribution was at first by wooden pipes, which failed, and have been replaced by cast iron-pipes, of which 3 miles are laid, of from 8 to 3-in. diameter, with 23 fire hydrants and 18 gates. The number of taps is not given. Service pipes are of lead and galvanized iron. The population in 1880 was 1,192. The consumption is not given.

The works have cost $25,000. The bonded debt is $19,350, bearing 6 per cent. interest.

The expenses of maintenance in 1880 were $800, and the receipts $2,800.

The works are managed by the Water Committee of the Common Council and a commissioner appointed by the Council, who is the superintendent and collector.

J. W. Hughes has been chairman of the Water Committee from the first. John P. Ford was commissioner for several years. The present commissioner is John Bruce.

(TO BE CONTINUED.)

CORRECTION.—April 1, 1882, p. 106, *Scranton, Pa.* C. E. Judson, C. E., corrects the report to read as follows: Third paragraph, "Roaring Brook Reservoir was 1½ miles from the city, 250 ft. above the Lackawanna River, or 150 ft. above general level of the city." After fourth paragraph add "the Roaring Brook Reservoir, 1½ miles from the city, was abandoned and a new one built, 4½ miles from the city, 400 ft. above the river, or 300 ft. above the city, as described further on." To the financial statement adds: "There is no bonded debt, and the company pays regular quarterly dividends of 2½ per cent."

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THE IRON AND STEEL TRADE.

The uncertainty as to the volume of railroad building and general construction into which iron and steel enters largely has produced two effects, which have both their advantages and disadvantages—first, less demand; second, less price. Enterprise was beginning to suffer from the advancing tendency on cost of iron, steel, and other material. Contracts were not entered into; projected undertakings were delayed. The declining tendency in prices, instead of drawing out this demand and starting this business, still keeps it out of sight, for the reason that buyers and investors and projectors desire not so much cheapness, but security, assurance, confidence that the bottom is not leaking, that there is a fair guarantee that a dollar spent will return at the end of a year with a dime. This is the present feeling in mercantile and manufacturing circles. There is a readiness to push out again in all manner of commendable enterprises, and it is hazarding no prediction to say that the first solid evidence of an abundant crop and a possible satisfactory expert trade will result in an improvement in industrial enterprises. In fact, the actual requirements of trade are employing the entire available iron and steel making capacity. Furnaces are sold ahead, the most of the iron mills have a fair supply of orders, the steel mills are full of work at high prices, the steel rail mills will feel no effects of the lull for months to come. Machinery, tools, engines, boilers, furnishing material for textile mills, foundries and all kinds of manufacturing establishments are being ordered freely. Extensions and improvements in shops outside and inside are being pushed if anything more rapidly than ever before. So far as present surface appearances go, there is no occasion for complaint. The apprehensions entertained have reference to the future. Stocks of all kinds of iron are very low. Foreign markets are active and prices are generally firm. Rather larger than usual imports are arriving, because of this fact home and foreign prices have been about equalized in most articles.

The trade is encouraged by the number of inquiries for iron and steel in various shapes. Bridge building is especially active. The construction of railroads in the far West may be temporarily suspended, but the building of bridges and the replacing of old ones with new ones, east of the Mississippi, is going on, as all who keep familiar with the daily progress of building know. The market quotations show that demand and supply are pretty evenly balanced. Buyers are buying for immediate wants only. Stocks are not accumulating. About the same number of furnaces are in blast as a year ago, but the producing capacity is much greater and is equal to about five million tons per year, not taking account of accidents or stoppages. Competition at home and threatened competition from abroad are an assured protection against high prices.

Merchant bar has weakened within a few days to 2.6@2.7c. per pound. Structural iron is quoted at 3@4c., which is about inside figures; tank iron 3c.; refined, 3½c. Capacity is quietly increasing, but the demand seems to keep even pace. The approach of summer will probably bring additional activity and a slight hardening in prices for small buyers. Steel rails have been sold recently at $53. Iron are quoted at $46; Bessemer pig at $24@$25; forge, $22 at furnace. With all the forces at work to stimulate production and encourage enterprise, it is probable that prices will remain throughout the summer nearly where they are to-day.

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STANDARD TIME.

To give our readers some indication of the direction and means by which this is to be effected we give some extracts from an address by President F. A. P. Barnard, read before the Association for the Reform and Codification of the Laws of Nations, at Cologne, Prussia, August, 1881.

The question has been examined by the American Metrological Society, in New York; the Imperial Academy of Science, St. Petersburg; the Royal Society, London, England; the Canadian Institute, Toronto; by the American Association for the Advancement of Science at Cincinnati; by the American Metrological Society in New York; by the Association for the Reform and Codification of the Law of Nations, at Cologne, Prussia; by the International Geographical Congress at Venice, Italy, and other scientific bodies.

Its importance has been fully admitted, and expressions of opinion have been obtained as to the means of overcoming the difficulties which are experienced.

As the continent extends across 105 degrees of longitude, an individual at the western limit finds himself seven hours of recorded time behind another individual at the extreme eastern side at the same moment of absolute time. Much of the intervening country is but thinly settled, but railways and telegraphs traverse from ocean to ocean, and we have every gradation of difference of time between the extreme limit of seven hours.

It is to be noticed, in the first place, that the time kept by clocks and watches in our country is not, generally, the exact local time of the place where the owners of such timepieces reside. Upon every great line of railway it is indispensable, in order to secure safety and regularity in the movement of trains, that the time kept should be uniform from end to end. And as some of these long lines extend over from five to ten degrees of longitude, while the standard time kept by them is usually that of one of their termini, it follows that, at different points of the road, the railway time differs from the local time, ten, twenty, thirty or more minutes. Yet, such is the relative importance of the railway traffic, in comparison with that of interests purely local, that, in practice, the railway time supersedes the local time, and all the affairs of life are regulated in accordance with it. In some large towns two kinds of time are kept; as, for instance, at Buffalo, N. Y., where, in the same houses, may be found two clocks, one of them giving the time of the place, and the other that of New York City, which is the railway time, and is twenty minutes faster.

It sometimes happens that towns not distant from each other are situated on different lines of railway keeping different times. In passing by ordinary vehicles, from one of these towns to another there is experienced the inconvenience of finding one's watch entirely out of harmony with the time-keepers of the locality visited. But a still greater inconvenience occurs in those towns which lie at the intersections of two or more important roads—and there are a good many such—for here it is necessary to keep account of as many systems of time as there are intersecting ways. From an investigation made by Professor Cleveland Abbe, of the United States Weather Signal Office, at Washington, it appears that the railway times kept by different transportation companies in the United States correspond to no fewer than seventy meridians, and the total number of such varieties is probably not less than one hundred. Now, so far as the transaction of the ordinary affairs of life in each particular locality is concerned, this extraordinary variety is of no consequence to the inhabitants. But in all matters which concern the mutual relations of the inhabitants of different places the case is otherwise. Without a knowledge of the times of both places it is quite possible that appointments in regard to affairs of important concern may be wholly disconcerted. And without a similar knowledge one may fail to meet a train on which he had counted, and may thus be subjected to unanticipated delay and other consequent disadvantages. It is, of course, hardly necessary to mention the degree to which the usefulness of the time-tables issued by the various transportation companies is impaired, for the purposes of the traveler, when the time standards of all these companies are different. But the embarrassment to the tourist, however great, is of less importance than that which is suffered by the permanent resident.

Now, considering the fact that for our own continent of America the time actually kept at any place is usually purely conventional, and is not the true local time of the place itself, considering that this is also true in England, and is, probably, to a great extent true of the continent of Europe, and considering that identity of the conventional with the local time is unimportant when the standard of time actually used is understood, it has seemed to us that by the adoption of a system according to which all time-keepers throughout the world might be made to agree as to the minute and second, and to differ only, as longitudes differ, in regard to the hour, all the confusion which exists in consequence of the present variety of time-standards might be wholly eliminated, to the great benefit of the people of all civilized lands. The adoption of this system would involve the recognition of twenty-four fixed meridians, distant from each other by a constant difference of fifteen degrees of longitude, and determined in position by some one of the number distinguished as the *prime* or *zero* meridian. The moment of the passage of the mean sun over each of these meridians is to be regarded as the hour of mean noon for that meridian, and for all places which are nearer to it than they are to any other. Thus the largest difference which can occur between conventional time and true local time will be thirty minutes, and the hour will change at a line halfway distant between any two meridians.

The sytem here described was proposed originally for the United States by Professor Cleveland Abbe, of the United States Signal Service (as mentioned above), in a report to the American Metrological Society, and also (without concert with Professor Abbe) by Sandford Fleming, Esq., late Chief Engineer of the Canadian Pacific Railway, and now titular Chancellor of Queen's University, at Kingston, Ont., in a paper read by him before the Canadian Institute, and since published. In these papers it was proposed to adopt, for the American continent, five meridians, of which the central one should be situated six hours west of Greenwich, and should pass almost centrally through the city of New Orleans. The time of this meridian, being that prevailing through the principal States of the Mississippi Valley and the British province of Manitoba, is distinguished as *valley time*. The five-hour meridian passes near New York, and governs the States lying on the Atlantic, together with the two Canadas, giving them what is hence called *Atlantic time*. The four-hour meridian crosses the island of Newfoundland, and gives what is called *eastern time* to that island, and to Nova Scotia, New Brunswick and the remaining British possessions east of Canada. The seven-hour meridian passes through the city of Denver, and almost exactly over the United States Signal Station on the summit of Pike's Peak, more than 14,000 ft. high, in Colorado. It gives time to the States, Territories and provinces lying on and about the great central ridge of the continent, which is hence called *mountain time*. The eight-hour meridian falls a little east of San Francisco, and almost exactly on the small sea-coast town of Santa Barbara, in California. From this the States of the Union which lie on the Pacific, and the British provinces on the same ocean, derive their time, which it is proposed to distinguish as *Pacific time*.

The bounding lines between the successive meridians, at which the count of the hour shall change, it is not proposed to define with the same geometrical precision which characterizes the meridians themselves. The idea is rather to follow any well-known natural or political divisions which fall approximately midway between the meridians, and which will serve as easily remembered reference boundaries. On the American continent such lines of demarcation are easily found. The States and provinces which touch the Mississippi River will use valley time; the Canadas, and the States of the Union which lie east of the valley States, and most of which touch the Atlantic, will use Atlantic time; the British provinces farther eastward will use eastern time; the States and provinces which touch the Pacific will use Pacific time; and all those which lie between the Pacific States and the valley States will use mountain time.

The means by which we expect to establish this system on the American continent are partly the voluntary action of the transportation companies; partly the co-operation of municipal corporations and chambers of commerce, and partly local legislation.

Some minor features of the scheme contained in the resolutions proposed remain to be mentioned. The first of these is the proposition to abolish the present division of the day into equal portions of twelve hours each, and to employ instead a continuous count running from one to twenty-four hours in each day. The division at present in use is not a natural one. It is founded, presumably, upon the custom of astronomers to begin the day at the meridian passage of the sun, or the habit of the people to fix the moment of apparent noon by observing the coincidence of the shadow of a vertical stile with a line drawn north and south. The natural division of the day is into a light portion and a dark portion. These portions are always and everywhere unequal, except for a single day in the year, or for a single great circle of the earth—the equator. No exact system for the uniform division of time can, therefore, be founded upon them. On the other hand, no disadvantage can arise from regarding the day as a unit subdivided into twenty-four equal fractions, a mode of division once very general, at least in Italy, and hardly yet entirely abandoned; while there are very appreciable disadvantages attending the present division into twelve-hour moieties. The first of these is the necessity of using always in speech the word *forenoon* or *afternoon*, in order to identify the portion of the day to which any hour which happens to be mentioned is to be referred; or, in writing, to place after the number of the hour the explanatory suffix, A. M., or P. M. Another, and even greater, is the uncertainty in railway time-tables as to whether a particular hour is an hour of the night or of the day. The compact form of the tables renders it impossible always to introduce the necessary specifications in their columns, and the inquirer is thus often left at a loss. Some of these tables, in order to remove the embarrassment, have employed the expedient of printing the hours of the night in white letters upon a black ground, while those of the day are printed in the usual way—with black letters upon a white ground; but the very adoption of this expedient is a confession of the existence of an evil which we may easily perceive to be quite unnecessary. Let the hours of the day be only continuously numbered from beginning to end, and there will never be any uncertainty as to which part of the day is meant.

It is proposed that the community unite in an effort to simplify the system now in use by reducing the number of time standards to a minimum by substituting for an indefinite number of irregularly established and purely local standards a few main, or, as they may be termed, continental standards, each one having a fixed and well-known relation to all the others. It is proposed to have these standards established and maintained by governmental authority; to have them regulated with precision through a common central observatory, and through these standards it is proposed to keep every town, city, railway and steamboat clock throughout the land as nearly as practicable in perfect agreement.

The plan of arrangements favored is to have the standards so established that they will be exactly one hour apart; that is to say, while it would be nine o'clock at one standard it would be eight o'clock at the next to the west, seven o'clock at the following, and so on, by steps of exactly one hour. There would be no difference in the minutes and smaller divisions of time. If the time be ten minutes or thirty minutes past the hour at any one point, it would at the same instant, in absolute time, be ten minutes or thirty minutes past some hour at every point. The hours themselves only would differ, and they would differ only in designation according as the localities were east or west. At the same instant of absolute time every clock in the country would strike either one hour or another; the minute and second hands would always and everywhere be in perfect agreement.

These views have met with the ready acquiescence of all who have given them careful consideration, and the system recommended by the several scientific bodies for adoption on this continent, commends itself as a scheme which all nations may, with advantage to themselves and to general interests, accept, and based on the following propositions:

"1. Twenty-four standard meridions (one every 15 degrees of longitude) to be established around the globe for reckoning sectional or local time.

"2. One of the 24 standards to be selected as a time zero or initial meridian for reckoning cosmopolitan time.

"3. The time zero to coincide with the prime meridian to be common to all nations for computing longitude.

"4. The 24 standard meridians to be designated by names, or by letters of the alphabet, or by degrees of longitude, numbered from the prime meridian westerly.

"5. The prime meridian, or zero for time and longitude, to pass near Behring Strait 180° from Greenwich.

"6. The division of the day into two halves of twelve hours each to be discouraged, and a single series, numbered from I. to XXIV, substituted. In the cosmopolitan day, or period of time between two successive passages of the sun over the prime meridian, the single division to be made absolute."

The papers on the subject, giving all needed information with explanatory diagrams and tables, have been published in pamphlet form by the American Society of Civil Engineers, at their rooms, 127 East Twenty-third street, New York.

LITERATURE.

A Plat and Profile Book for Civil Engineers and Contractors. Published at office of Engineering News, 1882. Price, $1.

The accompanying engraving presents an accurate illustration of this book.

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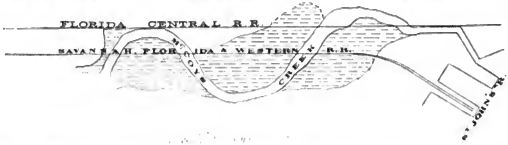
On the 17th inst., the U. S. Supreme Court, in a suit by Charles Guidet, involving the validity of his patent for a certain stone pavement, held, "that the improvement was not properly patentable on account of want of novelty, and that therefore the patent cannot be sustained." The opinion was written by Chief Justice Waite.

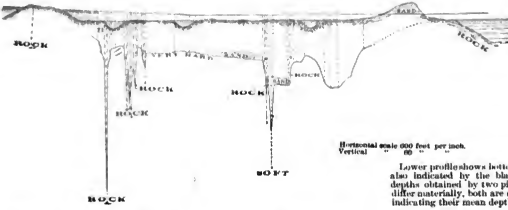
TRESTLE OVER McCOY'S CREEK, FLA.

BY W. B. W. HOWE, JR.

[Written for ENGINEERING NEWS.]

The Waycross Short Line, which was opened to the public about a year ago by the Savannah, Florida & Western Railway, presented during the construction but few features of engineering interest, traversing, as it does, a pine barren, almost unbroken, from Waycross, Georgia, to Jacksonville, Florida.





Horizontal scale 600 feet per inch.
Vertical " 60 " "

Lower profile shows bottoms of piles, which are also indicated by the black dots. Where the depths obtained by two piles of the same bent differ materially, both are shown, the profile line indicating their mean depth.

I have frequently heard it remarked, in speaking of the numerous projected lines of railroad which traverse the map of Florida, and afford a never-ceasing source of wonderment to the more conservative railroad men of the country, that their construction would consist chiefly in laying the cross-ties and iron, and digging a side ditch or two. This sounds refreshing when contrasted with construction in a rocky, or what might be called a "hard country," but however true it may be in many cases, particularly on projected roads with limited capital, it would be wiser to acquaint ourselves with the special characteristics of the locality before assuming that in escaping the difficulties presented by one extreme we will not encounter those of the other. The following remarks, based on my field notes, are not intended to illustrate railroad building in Florida, but only to present to your readers certain peculiarities of a Florida marsh which were brought to my observation while engineer for the construction of a portion of the Waycross Short Line, together with the methods adapted for overcoming the difficulties presented.

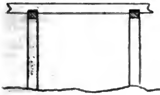


Fig. 1

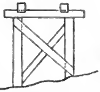


Fig. 2

Scale, 10 feet per inch.

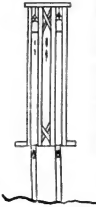


Fig. 3

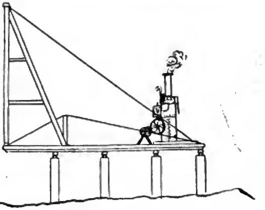


Fig. 4

Scale, 20 feet per inch.

The location selected for the terminus of the Waycross Short Line, at Jacksonville, Fla., was on the left bank of the Saint Johns River, at the mouth of McCoy's Creek, the approach to which could only be effected over this creek and its adjacent marshes. By referring to the accompanying map, it will be seen that in the distance of less than a half-mile the located line crosses the creek three times. Considerable difficulty was apprehended in the construction of this portion of the line, as it was known that the piles which carry the Florida Central Railroad trestle had been driven to the depth of 80 ft. without reaching bottom. In this case the difficulty of foundations had been overcome by increasing the number of piles and introducing intermediate bents, so that in the finished trestle the spans varied from 6 to 15 ft., which gave to the whole an exceedingly slovenly and patched-up appearance, and must also have proved an expensive method of construction.

The difficulties presented in the construction of the Waycross Short Line had to be overcome in a more systematic manner. Three methods presented for consideration. The first, to build a bank on mattresses across the marsh; the second to construct a permanent trestle, and the third, to build a temporary trestle which would be filled in by trains before renewal was necessary. The first proposition was inexpedient in view of the time required for its execution and the lack of filling material available. The second would involve unnecessary expense if the intention of filling in was carried out within a reasonable time. The third proposition was therefore decided upon as most expedient. The general character of this trestle is shown in Figs. 1 and 2, and consisted of bents 12' 6" between centers, each bent being formed of two round piles 6' 6" between centers and capped with double caps, the lower 10"×12", mortised and tenoned to piles, and the upper, or shimming cap, 4"×12", pinned to the lower cap with three $1\frac{1}{2}$" wooden pins. Each bent was also braced transversely with X braces of 3" plank spiked to the piles. The stringers which spanned the spaces between the bents were 12"×14", notched one inch on to cap, which was also notched an inch to receive stringer. These stringers broke joint and were pinned to the caps except at the crossings of the creek, where they were spliced with 2" plank, bolted on.

The difficulties in the way of building any kind of trestle over a marsh as soft as the one in question consist principally in the transportation of the machinery and material. These must be handled on a tramway or on skids, the shifting of which from place to place is an item of expense which amounts to a considerable proportion of the cost of the whole. In the case under consideration, the difficulties were enhanced by the three crossings of the creek, where it would be impracticable to transport the machine on skids, and where it would be necessary to transfer the pile driver to a lighter from which it could be operated.

There was, very fortunately, available just at this time a large steam pile-driver which had been constructed for work of a similar character on another part of the line. This machine, an idea of which may be had from Figs. 3 and 4, consisted of a carriage 50' long, composed of two runners of 12"×12" timber firmly braced laterally and shod on the under side with bars of railroad iron. Upon one end of the carriage was built a platform, upon which the engine was located, and upon the other the hammer-guides and customary framing were placed. The whole was arranged to operate two hammers, each 1,900 lbs. in weight, and as the guides were placed 6' 6" between centers, both piles of a bent could be driven without changing the position of the machine. The framing and counterpoising was so adjusted that the iron shoes on the bottom of the runners would rest in grooved rollers placed on the heads of the piles already driven, the hammer frames projecting beyond the last bent to the site of the next; in this position the weight of the projecting portion was counterpoised by the weight of the engine and frame behind the last bent. The piles for the new bent having been driven were cut off at the proper height, rollers put upon them and the machine hauled ahead by attaching a line from the hoisting drum to one of the piles, under the forward part of the carriage. One of the peculiar advantages of this machine, as will be seen, was that it required no skids or scaffolding for its transportation except the **X** braces and stays to hold the head of the pile steady while it was moving ahead. It would also cross the creek as easily as the marsh.

The locomotives in use on the Savannah, Florida & Western Railroad would concentrate a weight of slightly more than 18,000 lbs. on each pile, and it was deemed of great importance to have these reach a firm bearing. The specification, therefore, required that each pile should be driven until the average settlement per blow during the last three blows of the hammer, under the full fall of 25' should not exceed 1½". This was adhered to throughout the work, with the exception of a few instances where quite a thick stratum of sand was encountered, into which the piles penetrated with great difficulty. Here it was thought they would possess considerable frictional stability.

The first pile driven gave no evidence that anything unusual was to be expected, receiving 30 blows and bringing up with the required settlement at a depth of 14 ft. The 30th pile was the first which gave indications that more or less difficulty was to be encountered. From this point, as will be seen by reference to the section, the piles increase in length, reaching the maximum at the 34th pile, which received 293 blows and attained a depth of 134' and 6" (134.5 ft.) This pile was composed of 9 sections, connected at the joints with round iron dowells, 1½" × 12", and was driven with great care, as there was considerable danger of one section jumping off of that below it. So soft was the mud that the first section of a pile would frequently descend the full length of the hammer guides without receiving a blow, and it was found necessary to put check chains on the hammers to prevent their moving out of the guides and being lost in the mud. After driving the second section of a pile the settlement would become comparatively uniform for each blow until bottom was reached, when the descent would be abruptly checked. So sudden and marked was this change in the rate of descent per blow that I felt no doubt in attributing it to the presence of rock similar to that found at varying depths in several borings I had made in the immediate vicinity, and which proved to be a very compact white marl, which in the mineralogical scale of hardness would correspond to 2½. Where this rock was exposed upon the bottom of the river with no overlying mud, it became necessary for the piles to be driven some distance into it to obtain the requisite steadiness. To accomplish this, they had to be shod with iron points, and even then were handled with difficulty. The rock was evidently much fissured, and cracks could be found with an ordinary probing rod. It would frequently happen that a pile after having been driven into the rock 3 or 4' would strike one of these fissures and spring completely out of the hammer guides. The piles for the wharf in the river were driven from a flat with a hammer of 2,240 lbs. The effect of this hammer with a fall of 25' on a pile resting on an unyielding bottom was well illustrated in one which was pulled up, because it was suspected that the shoe had failed to penetrate the rock. As will be remembered, the piles to be driven to a settlement of 1½" for the last blow. In the case in question the pile had for several blows been settling slightly more than this, and when pulled up it was found that the end of the pile, which was about 9" in diameter, had been browed for a length of 3'. This would seem to be an argument in favor of a heavy hammer and low fall, and probably a heavier hammer would have proved efficacious under a low fall; but with the one in use, after trying both plans it was found that quite a heavy blow was required to make any impression whatsoever.

But to return to the long pile above-mentioned, it may not be amiss to remark here that it was driven half on one day and so left over night. When work was resumed the next morning careful observations were made to ascertain whether the friction upon its sides had increased at all during its static condition, as had been recorded in the case of other long piles, but no difference could be detected in the settlement per blow from that produced by the last blow of the previous day.

Were all the piles to be as deep as this it was evident the cost of the work would be proportionately large. The device, therefore, was tried of increasing the bearing surface of each pile by bolting to it a platform of timber 4' square. The platform was made by bolting on each side of the pile one piece of 6" × 12" timber 4' long and placing beneath them 3" plank 4' long at right angles to the pieces of timber. When the pile was driven this was forced down into the mud. The pile at *B* carries one of these platforms on its second section.

It had been observed that at about 30' below the surface a more or less compact stratum was encountered, but which was so thin that the piles would penetrate it and pass into soft material below. The object of the platform was only as an auxiliary support, so that it became necessary to ascertain the depth of the stratum at the position of each pile, and locate the platform so that it would not bring the pile to a stand until it had reached the stratum referred to, while at the same time it should oppose further settlement. This was determined with an ordinary gas pipe sounding rod, which could be forced down to the hard surface, but not through it, so compact was the material. The platform device worked well, but was only used in a few instances, as the stratum referred to increased in strength in the distance of the next two bents sufficiently to prevent the piles pushing through.

While the piles were of such great length it was thought best to stay them by some means. To accomplish this four bents were selected, two on each side of the long piles. These bents were composed of piles of single sections; on the outside of each of them single piles were driven, and the heads driven in under the bent caps and bolted. This gave two bents of two plumb and two batter piles, each on either side of the long pillar bent. Between these and over the intermediate bents a system of lateral bracing was run, which gave great steadiness to the whole.

Longitudinal **X** bracing was introduced wherever it would avail anything, but the greater part of the trestle was so low that it was not needed.

The whole of the work was done by day's labor, and cost $1.92 per running foot for everything below the cross-ties. The trestle has been in use by freight trains since Oct 1, 1881, and by passenger trains since Jan. 1, 1882, and has given no indication of lack of stability.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 131.

CCLXXXIV.—CEDAR RAPIDS.

Cedar Rapids, Iowa, in lat. 41° 58' N., long. 91° 40' W., on Cedar River, is on slightly rolling ground rising gradually from the river for about half a mile to bluffs of from 25 to 50 ft. high, on which many dwellings are built.

Settled in 1839, it was incorporated as a city in 1856. Water-works were built by a private company in 1875, after the plans of J. T. Cushing, taking the supply from Cedar River, which has a water-shed of about 700 square miles. The water is pumped directly into the mains by steam machinery built by McGowan. There is one compound condensing engine with steam cylinders of 26¼ and 28-in. diameter and 30-in. stroke, and one engine with 16-in cylinder of 24-in. stroke, operated either as condensing or non condensing. There are two double-acting piston pumps of 13-in. diameter and 30-in. stroke, and two of 10-in. diameter and 24-in. stroke. The ordinary pressure is 60 lbs. and the fire pressure 800 to 100 lbs.

Distribution is by 8 miles of cast-iron pipe of from 16-in. to 4-in. diameter, with 76 fire hydrants and 875 taps. The city pays $75 to $100 per year for each hydrant. Both lead and wrought iron are used for service pipe.

The population in 1880 was 10,104, and the daily consumption 550,000 gallons.

The capital stock of the company is $66,000, and there is a bonded debt of $65,000, bearing 8 per cent. interest. The expenses and receipts have been as follows:

	Maintenance.	Interest.	Receipts.
For year ending Mar. 31, 1881	$6,493.43	$6,162.73	$14,530.61
For year ending Mar 31, 1882	7,463.41	6,085.04	15,877.22

F. O. Weeks is Treasurer of the company, and C. J. Fox the Superintendent and Engineer.

CCLXXXV.—ANDES.

Andes, New York, in lat. 42° 13' N., long. 74° 42' W., is on Tremper's Kill, a small stream in a hilly country. Settled about 1817, it was incorporated as a village in 1861 and re-incorporated in 1879.

Water-works were built by a private company in 1876, under the superintendence of Thomas S. Miller.

The supply is taken from two springs which issue from opposite sides of a large rock, and yields about 140,000 gallons per day. The streams unite below the rock, and the water is led 12 ft. through a 6-in. pipe, over the wall of a reservoir 50 ft. square and 8 ft. deep, formed by a wall of stone laid in cement and blue clay, 4 ft. wide at bottom and 2 ft. at top. The reservoir is 160 ft. above the village, to which the water is conveyed through a 6-in. cast-iron pipe which is laid under the lower wall and across the bottom of the reservoir to the influent pipe.

Distribution is by 1½ miles of 6-in. and 3-in. cast-iron pipe, with 20 fire hydrants, 4 gates and 100 taps. The village exempts the company from taxation, in consideration of the use of water for fires. Lead service pipes are used.

The population in 1880 was 496 and the daily consumption 3,000 gallons. The capital stock of the company is $6,000. The works have cost to the present time $7,000 and the receipts have been $2,300. There is no debt. The expenses in 1880 were $25 and the receipts $380.

Barua Johnson is Secretary and Treasurer and Thomas S. Miller Superintendent.

CCLXXXVI.—LEROY.

Leroy, New York, in lat. 42° 57' N., long. 78° 0' W., is on Oatka Creek, which supplies a fine water-power.

In 1875 water-works for fire protection only were built by the village, taking the supply from the creek. Two water wheels in a mill drive 2 La France pumps which force the water through 2 miles of 6-in. cast-iron pipe, with 20 fire hydrants. No financial statements are given.

The population in 1880 was 1,468.

CCLXXXVII.—ST. JOHN AND PORTLAND.

St. John, New Brunswick, in lat. 45° 10' N., long. 66° 5' W., on the Bay of Fundy at the mouth of the St. John River is on a rocky peninsula with steep slopes. Settled about 1780, it was incorporated as a city in 1785. Portland, of later settlement, and under a separate municipal organization, adjoins St. John, and is supplied with water from that city. Water-works were built in 1836 by a private company, taking the supply from Lily Lake, a natural pond 80 ft. above the base of city levels and about 2 miles from the city. Leinster reservoir, 143 ft. above base of levels, built of masonry and holding 300,000 gallons, was filled by pumping with a steam pump three or four times a week. The water was allowed to enter the distributing pipes only from 6 to 8 o'clock in the morning of each day, during which time consumers had to draw their daily supply.

In 1849 the company built additional works after plans of George H. Bailey, C. E., taking the supply from Little River, about 4 miles from the city, where an impounding reservoir of 87½ acres area was constructed at 160 ft. above the city datum, and the water conveyed to the city in a 12-in. cast-iron pipe, and the pumping works were abandoned. In 1851, Lake Latimer, of 200 acres area, at 300 ft. above city datum, was made available by damming its natural outlet into Mispeck River, and connecting it by a conduit with Little River. In 1855 the works were purchased by the city. In 1857 another supply main was laid, of 24-in. diameter, and in 1873 another of 24-in. diameter. The regular daily supply is now taken from the Little River reservoir, the Leinster reservoir being used for fire purposes only.

Distribution is by cast-iron pipe of from 15-in. to 3-in. diameter. There 32.15 miles in use, with 276 fire hydrants, 49 free hydrants for the use of the poor, 671 gates, 3,733 taps, and 121 meters. Lead pipe is used for all services of 1 in. or less diameter.

The total cost of the works to Jan. 1, 1882, was $987,471.59. This includes interest and maintenance.

The cost of maintenance and repairs in 1881 was $12,844. The revenue from "agreement customers" was $9,279.33 and the assessment on property for water purposes was $68,099.90. The population of the two cities is about 32,000. St. John was almost totally destroyed by fire June 20, 1877. On Nov. 23, 1880, the supply of water was suddenly cut off for some hours by the formation of anchor ice or *frasil* in the outlet chamer at the reservoir.

The works are in charge of a board of commissioners of water-works and sewerage. Gilbert Murdoch, C. E., is the Superintendent.

CCLXXXVIII.—BRISTOL, PA.

Bristol, Pennsylvania, in lat. 40° 7' N., long. 74° 47' W., on the Delaware River, is on nearly level ground, 12 ft. above high water in the river. It was settled in 1684. Water-works were built in 1875 by a private company, after plans of William E. Morris, taking the supply from the Delaware River and pumping it by two Worthington duplex steam-pumps of 16-in. steam and 10-in. water cylinders into a stand-pipe 6 ft. in diameter and 140 ft. high.

Distribution is by 8½ miles of cast-iron pipe of from 12 to 4-in. diameter, with 180 taps. There are no fire hydrants. Service pipes are of lead.

The population in 1880 was 5,474. The daily consumption is 130,000 gallons, about two-thirds of which is used by the locomotives of the Pennsylvania Railroad.

The original cost of the works was $89,450, and $4,300 have since been spent in extensions. There is no debt.

The receipts and expenses since May, 1878, have been as follows:

	Receipts.	Expenses
Year ending May, 1879	$5,414.67	$2,068.53
" " " 1880	5,650.13	2,830.85
" " " 1881	6,626.39	2,710.06

Anthony Swain is President of the company, Anthony K. Joyce the Superintendent, and G. M. Dorrance the Clerk.

CCLXXXIX.—BETHLEHEM.

Bethlehem, Pennsylvania, in lat. 40° 36' 24" N., long. 76° 56' 8" W., is on the northeast fork of the Lehigh River and Monoquacy Creek, on high and uneven land. It was settled in 1741 and incorporated as a borough in 1845.

Water-works were built in 1754, by Hans Christopher Christiansen, a millwright and a native of Denmark. These are believed to have been the first works for public water supply built in the United States. The water was taken from a spring issuing from magnesian limestone, near the banks of the Menogassi Creek, as it was then called.

The water was conducted 350 ft. through an under conduit into a cistern, whence it was pumped by a lignum vitæ pump of 5-in. bore, through bored hemlock logs, to a height of 70 ft., into a wooden tank in the village square. Trouble was experienced from the bursting of the pipes, and 1½-in. pipes of sheet lead, soldered along the edges and bedded in a cement of pitch and brick dust and laid in a gutter of brick were tried without much success.

In 1762, Christiansen, aided by John Arbo and Marshall, constructed larger works. An 18-ft. undershot wheel drove three single-acting force pumps of iron of 4-in. bore and 18-in. stroke. The force main was of gum wood and the distributing pipes of pitch pine. The latter had to be renewed in 1769. In 1786 lead pipes were substituted for the gum wood force main and for most of the distributing pipes. The last pitch pine pipes were abandoned in 1791.

The reservoir was a wooden tower in the "little square." This was removed in 1808 and a stone tower built on Market street, about 15 ft. high, in which was a tank at an elevation of 112 ft. above the spring. A reservoir 70 ft. long, 10 ft. wide and 7 ft. deep was built in 1817. In 1832 another reservoir was constructed on higher ground and the water tower abandoned. In 1832 the triple pumps were replaced by one double-acting pump. In 1868 steam-power was used for pumping, and in 1874 a second steam pump was added. It is double acting, with 12-in. bore and 36-in. stroke. In 1874, the wooden conduit from the spring to the pump-house was replaced by an 18-in. iron pipe. In 1872, the present reservoir, a circular iron tank 40 ft. in diameter and 8 ft. high was placed at a point 149 ft. above the spring.

The water is pumped directly into the mains, the tank being used only as a regulator of pressure.

There are 4 miles of cast-iron pipe of from 8 to 3-in. diameter, with 75 fire hydrants, 80 gates and 350 taps.

The population in 1880 was 5,000.

The works were controlled by the Bethlehem Water Company from 1845 to 1871, when they were purchased by the borough for $20,300. The cost of the works has been $30,000 to the present time. The bonded debt is $38,000, bearing 4½ per cent. interest. The expenses in 1881 were $5,000 and the receipts $8,600. The works are managed by the borough council through the water supply committee, of which C. M. Anstatt is Chairman. Charles Bodder is the Superintendent.

CCXC.—CHATEAUGAY.

Chateaugay, New York, in lat. 44°-56' N., long. 74° 5' W., is on nearly level ground, with a gradual slope to the north.

Settled in 1796, it was incorporated as a village in 1868.

Water-works were built in 1880 by a private company, after the plans of Carlisle E. Smith and John Hughes, taking the supply from a spring issuing from a ledge of rock 50 ft. high. The constant yield of the spring is about 1,500,000 gallons per day.

The water is collected in a basin 80 by 24 ft. and 4 ft. deep, built with stone masonry. It is half a mile from the village and 125 ft. above it.

The distribution is by wrought-iron and cement pipe of 6 and 4-in. diameter. Three miles of pipe are in use, with 14 fire hydrants, 5 gates and 100 taps.

The village pays $200 per year for the use of fire hydrants.

Service pipes are of galvanized iron.

The population in 1880 was 1,000. The daily consumption is about 20,000 gallons.

The capital stock of the company is $10,000. The works cost $9,500, and the receipts in 1881 were $800.

John Hughes is the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is aknowledged with thanks: From John Hughes, Superintendent, statistics and water rates of the water-works of Chateauguay, N. Y. From Charles W. Knight, Engineer, twenty-ninth annual report of the Canajoharie (N. Y.) Water Company. From Timothy Woodruff, Superintendent, fourth annual report of the water-works of Bridgeton, N. J. From F. O. Weeks, Treasurer, statistics and reports of the water-works of Cedar Rapids, Ind. From Gilbert Murdoch, C. E., special report on water supply of St. John and Portland, N. B. From B. Johnson, Secretary and Treasurer, statistics and water rates of the water-works of Andes, N. Y. From G. M. Dorrance, Clerk Water Co., statistics and water rates of the water-works of Bristol, Pa. From Charles M. Anstett, Chairman Water Supply Committee, statistics and water rates of the water-works of Bethlehem, Pa. There are no water-works in Bloomfield, N. J., nor in Barrie, Canada.

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THE PENNSYLVANIA STEEL COMPANY.

The following paper was read by L. S. Bent, superintendent, before the Harrisburg meeting of the American Institute of Mining Engineers:

The works of this company, the largest in Harrisburg, lie between the Pennsylvania and the Philadelphia & Reading railroads, on the Pennsylvania Canal, and are essentially devoted to the manufacture of Bessemer steel rails. Capital stock, $2,000,000; invested in business, $5,000,000; wages per month, $80,000; employs 2,000 men; capacity, 100,000 tons of rails per year, which is being increased to 130,000 tons.

The plant, as it now stands, comprises five Bessemer converters, two 7-ton and three 8-ton converters, two 15-ton open-hearth furnaces in operation, and two 30-ton open-hearth furnaces in course of construction, one blooming mill, one rail mill, seven steam hammers, two blast furnaces in operation, two blast furnaces in course of construction, foundry, pattern shop, machine shop, blacksmith shop and frog shop, and merchant mill in course of construction.

Bessemer No. 1 was built in 1865, with two 7-ton converters, 2 spiegel cupolas 3 ft. diameter, and 3 iron cupolas 6' 6" diameter, and has a capacity of 500 tons in 24 hours. The blowing engine is a horizontal condensing engine, with two steam cylinders, 40" x60", and two blowing cylinders, 54" x60". Pressure of blast, from 20 to 25 pounds.

Bessemer No. 2 was built in 1881. It has three 8-ton converters, served by two hydraulic ladle cranes, in two casting-pits, and six hydraulic cranes for setting and drawing molds, handling bottoms, etc. The hydraulic pressure is 300 lbs. per square inch. The blowing engine is compound horizontal, with a high-pressure cylinder, 25" x70", and low pressure, 50" x70", with separate air-pump condensers, and also a Bulkley condenser attached. Pressure of blast, 25 to 30 lbs. This engine was built in the Pennsylvania Steel Company's shops. There are four iron cupolas, 6' 6" diameter, and four spiegel cupolas, 3' 0" diameter, blown by two No. 7 Baker blowers, or two 3-cylinder blowing engines.

The capacity of this Bessemer has not yet been determined, as it has only been in operation two weeks. There are many points of improvement over the old Bessemer which cannot be described in this paper for want of time. All the castings, boilers, roofs, wrought-iron work and engines of this plant were made and erected by the Pennsylvania Steel Company.

The Blooming Train is three high; rolls 34" in diameter, driven by a vertical condensing engine, 44" x54" cylinder. The capacity of this mill has never been determined, but is easily 600 tons in 24 hours. The ingots are delivered hot to the blooming mill from the Bessemer, and charged into 4 Siemens heating furnaces, 6 ingots being a charge for each furnace. The ingots are 14" square and make 4 rails each. The blooms are cut under a 4-ton steam hammer (Sellers), and are loaded by an hydraulic crane on buggies, which are pulled by a water engine to the rail mill.

The Rail Train is three high; rolls 23" diameter, driven by a 40" x60" engine, with Bulkley condenser attached. This train has rolled 1,916 rails in 24 hours. The saw-train is Gustin's patent. Two straightening presses and two drill dresses handle the rails as fast as rolled.

Open Hearth Furnaces, built in 1875, consisted of two 6-ton furnaces, which were enlarged later to 15-ton capacity. The new open-hearth furnaces in course of construction are each 30-ton. Each furnace has a casting-pit, and the two are served by five hydraulic cranes.

A 14 ton Steam Hammer is placed between the blooming mill and rail mill. Under it heavy shafts, cross-heads and piston rods are forged. When not in use for heavy work it hammers special steel into slabs and billets.

A 4-ton Hammer, adjoining the blooming mill, and a 1-ton hammer in the rail mill are used almost exclusively for slabs and billets.

The Foundry, 60' x225', has two cupolas, 5' 0" diameter, two core ovens, and five 15-ton steam cranes. All ingot molds are made here, and all castings for repairs and new work. The capacity of the foundry is 40 tons of finished castings a day.

The Pattern Shop has two circular saws, one Daniel's planer, one hand planer, a bandsaw, and one lathe, and bench room for 14 men.

The Machine Shop is 75' x 230', and contains 13 lathes, from 96" to 10"; five planers, which take from 8" square to 20" square; one 48" boring lathe, one 84" boring and turning machine, three 10' radial drills, two drilling machines, two shapers, two slotting machines, two horizontal boring machines, two bolt cutters, one pipe cutter.

The Blacksmith Shop, 60' x 75', contains two 1,000-pound steam-hammers and 14 fires.

The Boiler Shop, 75' x127', contains 3 drill-presses, 2 shears, 1 punching machine, bending-rolls, and 1 hydraulic riveting-machine. In this shop all steam-boilers, draft-stacks and iron-roofs are built.

The Frog Shop, 60' x400', has a capacity of $30,000 to $40,000 per month in railroad frogs and switches, crossings and interlocking apparatus. It contains 14 planers, 6 drill-presses, 2 slotters, 2 lathes, 1 milling-machine, 1 shaper, 1 pin-machine, 1 steam-hammer, 1 combined punch and shear, 1 single punch, 1 steam-riveter, 1 hydraulic bending-machine, 10 fires, and 1 heating-furnace. A new frog shop is to be put up immediately, 80' x400', with improved facilities.

Blast Furnaces.—No. 1, 14' x60', is blown by a vertical condensing engine, 84" blowing cylinder, 48" stroke; it has 4 pipe-ovens, of Kent's pattern; the fuel used is anthracite coal and coke; the ores are native Pennsylvania, Virginia and New Jersey, and Spanish and African. The product 50 to 60 tons per day.

No. 2, 20' x76', is blown by two vertical condensing engines, 84" x48"; 3 Whitwell stoves, 18' x60'; fuel and ores are the same as No. 1; product 840 tons per week. The product of both furnaces is used in the Bessemer.

No. 3 and No. 4 blast-furnaces are each 16' x65'. They are to be blown by vertical condensing-engine, 70" x48", 2 blowing cylinders to each engine, with capacity for 22,000 cubic feet of air per minute. These engines are being built by the Pennsylvania Steel Company. Each furnace has 3 Whitwell stoves, 18' x60', and will use the same fuel and ores as Nos. 1 and 2.

A Merchant Mill is in course of construction. The building, 100' x400', will contain one 12-in. roll train and one 20-in. roll train; the first driven by a horizontal Hughes & Phillps engine, 22" x30", the second by a horizontal Porter-Allen engine, 32" x48".

The Heating Furnaces are Sweet's patent.

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LACK OF CARE IN THE DETAILS OF IRON-WORK.

A paper on practical iron-work was recently read before the Civil and Mechanical Engineers' Society, England, in which it was remarked that sufficient care is not taken in the details of iron-work. The points of attachment will generally be found to be the weakest part; the compression members are considered as being able to bear four tons per square inch, while experiment and theory both seem to show that the strain which wrought-iron columns of the form in which struts are generally made can sustain more nearly approaches 2.7 tons per square inch of section, and that this value is in many cases too great. The loss from riveting in small girders is greater than is generally allowed for. The present form of upper and lower members in girders might be altered with advantage, vertical plates being used in the tension boom and gusset plates employed for attachment, allowing rivets in double shear. In bridges of small span ordinary lengths and sections of iron should be employed, but in large span bridges, when dead load predominates, greater refinement in designs may be used with advantage. All iron-work should be designed with regard to its erection, and in that which has to be sent long distances there should be no overhanging pieces of any length.

Continuous girders, though economical in first cost, are objectionable for use in road bridges, owing to vibrations, and it is doubtful whether their use is economical or safe in the end. Repeated shocks or vibrations producing fatigue will eventually cause the failure of all iron structures in which corrosion is not allowed to alter the conditions under which they were built, and as it may be concluded that the vibrations in continuous girders are more numerous with an equal number of shocks of the same intensity than in those of the non-continuous type, the life of the former will be shorter than that of the latter. Alterations in foundations which often change the conditions essential to the safe working of continuous girders are less liable to exert their influence on non-continuous girders. Close spacing of the cross girders of a bridge increases the number and extent of the vibrations and has an injurious effect on the girders themselves. The ignorant use of continuous girders may constantly be seen in the construction of warehouses and houses, where no care is taken to space the supports properly, where the quality of iron used is poor, where the margin of safety employed, as found from merchants' lists, is only from 2.7 to 3, and where failure of foundations is probable.

ENGINEERING NEWS.

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Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR. ....ASSOCIATE EDITOR.

SATURDAY, APRIL 29, 1882.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—ANNUAL CONVENTION, WASHINGTON, D. C., MAY 16, 1882.—The Annual Convention of the Society for the year 1882 will be held at Washington, beginning Tuesday, May 16, 1882. Sessions for professional discussion and one for the transaction of business will be held. At one of the sessions, the annual address will be delivered by the President, Mr. Ashbel Welch.

The general arrangements for the Convention are now in preparation, and will be announced. Details of the programme are in charge of the local committee at Washington, the chairman of which is Col. Thos. Lincoln Casey, Corps of Engineers, U. S. A., Director Am. Soc. C. E.

The families of members are invited to accompany them.

PAVEMENTS OF CITIES.

The American Asphalt Pavement Co., under the Desmedt patent, have laid a large extent of pavement in the city of Washington, D. C., and referring to it as meeting all the objections heretofore existing against such pavement, state it as the opinion of engineers that, "Washington is the best paved and cleanest city in the world." To accept this at its true value, the circumstances of the case must be taken into consideration. This we think is very much lost sight of in claiming for the American asphalt that its superiority over the foreign asphalt is such as to justify the opinion that this will be the "coming pavement." Although the opinions of engineers of prominence and city officials are given somewhat in detail, in which the statement is made, "that the pavement as laid in Washington is suitable for *heavy traffic* as well as light." In the opinion given by Gen. M. C. Meigs, he does qualify this so far as to say that, "it will be necessary to make *frequent renewals* of the wearing surface, but this is cheap." Yet he recommends it most unqualifiedly for heavy traffic. We do not doubt that for the wide avenues and streets of Washington, with comparatively light traffic, and the convenience offered for making repairs without interference with the traffic, this form of pavement will prove a great luxury, always supposing, as in Paris, that the surface is swept clean daily, and before the travel commences early in the morning, and at the same time slight repairs are made. In other words, the mud or dust not being allowed to collect and aid in cutting the pavement into ruts, and the *pavement never being allowed to get out of repair*. These two requirements are essential to its preservation and economical maintenance, and if faithfully carried out the greatest efficiency may be anticipated; but if neglected, as it is likely to be under the ordinary police of our American cities, nothing can be looked for but an intolerable nuisance.

There is another point which will ever prevent (unless a radical change is effected in the rights of property owners to occupy the spaces under the streets in the substructures) any pavement remaining in decent condition for any length of time, and that is the tearing up and loosely replacing in a slipshod manner the surface in order to lay pipes for gas, water or other purposes.

About the year 1871 the Russ pavement, which had been laid in Broadway at great expense under a patent, and which consisted of heavy blocks of granite laid flatwise on a concrete bottom, proved so dangerous for horses that it was taken up and the present pavement of granite blocks set on edge, known as the Guidet pavement, was substituted. This is an admirable pavement, and would have remained intact with all the heavy traffic of that street for 20 years to come. But after a short time some pipe was needed under the street and the pavement was taken up and, when replaced, was left a little higher than the remainder with a view to proper settlement, as was supposed. The result was the irregular settlement and cutting into ruts, so that the line of pipe a year after it was laid could be traced with the eye as readily as if the trench were still open. This was followed with other lines of pipes for various purposes and conducted in the same manner, and the result is that there are deep holes and prominences and ruts, which will render a general repairing necessary in a short time.

Some months since, Fulton street from Broadway to the Ferry was laid with the same kind of granite blocks, upon a thick bed of concrete, making such a pavement as the grinding action of the heavy carts and wagons frequenting that street called for. This street of cobble-stone pavement had for a long time been in a dangerous condition, and the completion of the granite block pavement was a boon to horse and man.

A few weeks since the Electric Light Company cut a trench on both sides of the street to within a block of the Ferry, and filling it over their pipes in the usual manner, the integrity of the pavement from curb to curb is destroyed, and the mischief is begun which will result as in Broadway. No police regulations, if any such existed, could be effectual to prevent the destruction before its time of any pavement with concrete foundation (as all pavements should have) which was constantly being ripped up in small patches, and replaced by the kind of workmen to whom such operations are confided.

Before we can have a permanently good pavement in any of our populous cities, the system of breaking it up at intervals must be abandoned. The right to build street vaults must be restricted, and all pipes must be laid under the sidewalks. Where large sewers exist, connections must be made by tunneling. The same difficulty now existing with us had been experienced in Paris, which led to the enlargement of the sewers and the laying of the pipes for water and gas on brackets at the sides and top, thus avoiding the necessity of breaking up the street pavement lengthwise of the street; and the system still exists to a large extent, forming what are called sub-ways, and it has been recommended elsewhere; but the difficulty experienced in preserving the gas-pipes free of leaks has proved so great, and the accidents thereby entailed so serious, that the method no longer finds favor.

The precise value of the American asphalt for pavements cannot be better shown than by an extract from Lieut. Green's, U. S. E., report on the Washington pavements. Although we must object to the length of time, *from* 15 to 20 *years*, which he gives for the lifetime of the asphalt, we would remark that the first cost of this pavement and that of granite blocks differs but little:

"The asphalt pavement is laid as follows: A foundation of 6 in. of hydraulic cement concrete and a wearing surface of bituminous mastic, laid in two coats, respectively ½ in. and 2 in. thick when compressed. The mastic is composed of the following parts by weight:

Asphaltic cement (refined Midland asphalt) 100 parts:

Petroleum oil, 20 parts	15 to 18	
Limestone powder	15 to 17	
Sand	70 to 65	
	100	100

The specification last year called for 18 to 20 per cent. of asphaltum cement, but experience showed that this proportion made the pavement too soft in summer, and the proportion actually used was between 15 and 17 per cent. The theory of this pavement is a solid base of concrete masonry, practically imperishable, and a comparatively thin and smooth wearing surface, which can be replaced when it is worn out—say every *fifteen or twenty years*. The concrete base is easily made, and satisfies all the conditions. In making the wearing surface, there are some practical difficulties which require constant attention and skilled, experienced labor. The pavement is subjected to a temperature of 150° in summer and — 10° in winter, a range of 160° Fahr., at all of which temperatures it is required to present a uniform surface. The danger in practice is that in extreme cold the surface will crack and become friable, and in extreme heat it will become so soft that it will roll or creep under the traffic, and present a wavy surface very uncomfortable to travel on. Refined asphalt is very brittle at a temperature of 60° Fahr. or less; when tempered with the heavy oil resulting from petroleum distillation it becomes ductile and tough, but if the heavy oil is added in excess—say above 20 per cent.—the mixture will fuse or run at a temperature of 150°, or even less. The problem is, therefore, to mix these two hydro-carbons in such proportions that the mixture shall neither be brittle nor liquid under the extremes of cold and heat actually experienced on the streets. Up to the present time the proportion of oil has been kept at about 20 to 100, or 16⅔ per cent. None of the pavements laid since 1878 have cracked under the cold (minimum—5° Fahr.) of the two winters since that date. A few of them have, in two or three small places, crept into waves under the heat of summer, as, in spite of all precautions, mistakes will sometimes occur in the preparation or handling of the material.

The mixture of asphalt (*i. e.*, mineral bitumen) and petroleum oil is the cement which binds together the particles of sand, which form two-thirds of the wearing surface and constitute its real resisting material. This cement must be less than enough to fill the voids in the sand, and only enough to bind them together when perfectly compressed. In order to reduce the voids as much as possible, ground limestone powder is added to the sand in the proportion of about 1 to 4. The powder is of such degree of fineness that it will all pass a 26 screen, and 75 per cent. of it will pass a 40 screen. The cement, as previously stated, is added in the proportion of about 15 to 85 of sand and limestone powder combined. The oldest pavement of this class is the one laid by the paving commission of 1878 on Pennsylvania avenue between Sixth and Fifteenth streets. This has now been on the street between three and four years, and the repairs (made at the expense of the contractors) are understood to have cost $2,142.50, or at the rate of $714.16 per annum, the number of yards being 53,198.80. The annual expense for repairs has been less than 1⅓ cents per square yard. On the compressed asphalt pavement laid by the Neuchatel Paving Company on Pennsylvania avenue between First and Sixth streets the repairs are reported to have cost about $1,867, or $622.33 per annum, the number of yards being 25,322.28. The annual expense for repairs has been about 2½ cents per square yard. This pavement of the Neuchatel Company is of the same character as those laid on the roadways in Paris. It is composed of *natural* bituminous limestone, which is broken and reduced to powder by heat, placed on the street in form of powder, and compressed by large iron rammers. The pavements which we are now laying in this city, under the name of asphalt, are *artificial* mixtures or mastics. Our investigations and practice are therefore on an entirely different line from those in Paris. The objections made to the Paris pavements are well known to be its slipperiness during a light rain or in damp weather, and the difficulty of cleaning. The contracts for maintenance provide for sanding the pavement when slippery, and for flushing it with a large amount of water and scrubbing with a rubber mop or "squeegee" in order to clean it. The same objections apply to the compressed asphalt pavement on Pennsylvania avenue, *while the mastics as laid here are almost free from these objections, owing to the gritty nature of the sand, which forms a large portion of the ingredients.* Where cut by plumbers, for making connections with pipes and sewers, *the surface coat does not show any appreciable wear.* The pavements are all to be repaired at the contractor's expense during the period of five years from date of completion, but as yet no repairs have been necessary except for cuts made by plumbers.

The entire surface of asphalt pavements on a concrete base in this city on the first of January, 1881, will amount to 360,000 square yards; of the so-called concrete pavements, of which the cementing substance was a product of coal-tar, the amount is 700,000 square yards, giving a total of 1,060,000 square yards of monolithic or smooth surface pavements, extending over a length of 44 miles. This is considerably more than exists on the roadways of all other cities in the world taken together—the amounts for other cities being as follows:

	Square yds.	Miles.
Paris	370,000	10¾
London	150,000	6¼
New York	20,000	1
Other cities (estimated)	60,000	3¾
	600,000	30

The so-called *concrete pavements* are, as a general rule, in a fair state of preservation; they are generally laid on a base of broken stone from 4 to 6 in. thick, covered with a layer of "binder" about 1 in. thick, composed of pebbles and a cement of coal-tar. The wearing surface was made in various ways according to the patent, but consisted essentially of small gravel, sand or stone dust, cemented by a product of coal-tar. In the later pavements of this variety a certain proportion of asphalt was mixed with the coal tar, and with beneficial results. Several of these pavements have stood the test of five years' wear, with little or no repairs, and are to-day in perfect condition; others were of inferior quality. When the top surface has worn off, these pavements begin to go to pieces very rapidly, and in order to save them from destruction they must be promptly covered with a new wearing surface. During the year 1879-'80, 53,486 yards were thus resurfaced; and 17,863 yards were entirely condemned, taken up and replaced with the standard asphalt pavement on a concrete base. During the current year about 15,000 yards have been resurfaced or are under contract.

Experience has, however, shown that by careful attention and constant repairs of small quantities in each, these pavements can be made to last much longer than was anticipated. Pavements, for example, which seemed on the point of destruction two years since, have by constant patching been maintained up to the present time and still present good surfaces. These pavements, however, were all laid within a few years of each other, and there is a possibility that after a few years more of wear they might all break up at the same time, during a severe winter, for example. It is, therefore, economical to gradually resurface a certain portion every year, and an appropriation of about $100,000 should be made annually for this purpose. A summary of these pavements is shown in the following table:

	Square yards	Cost.
Laid, 1871-'75	741,415.44	$2,284,004.01
Resurfaced, 1875-'78	218,842 00	329,378.60
Resurfaced, 1878-'80	53,436.81	59,187 40
Replaced, 1879	17,863.75	29,601 00
Minor repairs, 1875-'78	....	3,666 02
Minor repairs, 1878-'79	....	18,018 22
Minor repairs, 1879-'80	....	8,220.36
Total for repairs	....	448,182.09

These repairs extend over a period of seven years, *i. e.*, from 1873, the average time of laying, to 1880, and the average annual expense of repairs is, therefore, $64,026, or at a rate of 8⅔ cents per yard. This is certainly not an expensive rate for the luxury of smooth pavements. The asphalt pavements being composed of less perishable materials and being laid in a more substantial manner, it may be confidently expected that the cost of maintenance will be still less.

The minor repairs of concrete and asphalt pavements are made by contract let to the lowest bidder, and running for one year. These repairs include the damage done to pavements by plumbers' cuts, the actual cost of which is paid by the plumbers. The work to be done is specified by this office, and the whole city is carefully examined and repaired about four times a year, or oftener, if necessary. The work is done under careful inspection of experienced inspectors employed by the District.

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RADIUS OF GYRATION.

Clarke, Reeves & Co., with most commendable liberality, caused some 20 of their Phœnix columns, full sized, to be experimented upon in the United States government testing machine at Watertown arsenal up to their breaking strain, observing the limit of elasticity, etc. The results were read at the last annual convention and given to the American Society of Civil Engineers, and elicited a discussion in which a large number of its members participated. When it is stated that Bouscaren, Cooper, Whittemore, Emery, Wood, Strobel, Wurtell, Burt, Merriman, Gates, Howard and F. C. Clarke were of the number, it will be perceived that much interest will be attached to the papers contributed by these gentlemen. They are published in the last number of the Transactions issued by the Society, the February and March numbers being embraced in one publication. Space will not permit a review even of the points made by these several engineers, but in the interest of such of our readers as possibly wedded to the oldest and approved forms have not looked for new light in which to read the truths wrested from nature, we make an extract from Mr. Theodore Cooper's paper as showing the derivation of the generally received formula (Gordon's), and its comparison with a more modern one, and the circumstances under which the latter is entitled to the greater credit.

The results of these full-sized experiments show that Gordon's formula does not express the true strength of these columns, and it would appear that separate formula would be desirable for long and short columns below 15 diameters, a result indicated by Hodgkinson. The Phœnix columns are stronger than Gordon's formula indicates.

The experiments upon Phœnix columns made at Watertown Arsenal are a valuable addition to our stock of knowledge upon well-made columns of varying dimensions.

The well-known Gordon's formula—

$$\frac{P}{S} = \frac{36{,}000}{1 + \frac{l^2}{3{,}000\ h^2}} = \text{crippling strain per sq. inch,}$$

which has been generally assumed as the standard of strength for all wrought iron columns with square ends, had its numerical constants derived from a series of experiments made by Mr. Hodgkinson upon small bars and plates, whose cross-section varied from 1 in. square to that of a rectangle 5⅜ in. × 1 in. * * * * * * *

Though the formula was only intended to represent the strength of columns with a solid square or rectangular section, it has been generally applied to columns of all shapes of cross-sections.

The general form of the above formula was derived in the following manner:

The direct crushing upon any section of a column is represented by

$$\frac{P = \text{total load.}}{S = \text{Sectional area,}} \qquad (1.)$$

Any tendency to bend of a flexible column, free at the extremities, would increase the above crushing strain upon the concave side of the column, and relieve it upon the convex side. Analysis has shown that this increased strain due to the bending is theoretically equal to $\frac{P\,l^2\,\lambda}{\pi^2\,I}$ for the section at the center of the column $= \frac{P\,l^2\,\lambda}{\pi^2\,S\,r^2}$ (2) where P = total load on column, S = sectional area.

l = length, I moment of inertia, and λ the compression per square inch for a unit's length. This is identical with the formula for limiting strength given by Euler for long flexible columns which fail solely by flexure $P = \pi^2 \frac{E\,I}{l^2}$, if we reduce by substituting for E, modulus of elasticity, its value $\frac{f}{\lambda}$, f being strain per square inch due to bending only.

Summing equations 1 and 2 for total strain f, and representing the numerical quantity $\frac{\lambda}{\pi^2}$ by the constant a we get

$$\frac{P}{S} = \frac{f}{1 + a\frac{l^2}{r^2}} \quad \text{(3) Rankine's formula.}$$

Or for rectangular columns only

$$\frac{P}{S} = \frac{f}{1 + a\frac{l^2}{h^2}} \quad \text{(4) Gordon's formula.}$$

r being radius of gyration and h least side of rectangle.

From the experiments of Hodgkinson upon small bars and plates of wrought iron Gordon determined the value of a to be $\frac{1}{3000}$ for square-ended columns.

Rankine from the relation

$$\text{Mom. Inertia of a square} = \frac{S\,h^2}{12} = S\,r^2 \text{ or}$$

$$h^2 = 12\,r^2 \text{ or}$$

$$\frac{l^2}{3{,}000\ h^2} = \frac{l^2}{36{,}000\,r^2}$$

converted Gordon's factor into 36,000 for his own formula.

The numerical factors being obtained from the same experiments, both formulæ should be equally true for square or rectangular solid columns.

For any other form of column, Gordon's formula cannot be considered as applicable. Rankine's being of a more general form should be more nearly correct, and from the closer coincidence of the results obtained by Mr. Bouscaren, we are reassured of its greater correctness.

It, however, has not been generally used, no doubt from the apparent difficulty of obtaining the radius of gyration of various sections. This, however, can be readily overcome by substituting in the Rankine's form the average value for the radius of gyration of each particular form of cross-sections in terms of the least side or the diameter.

The relation existing between the least dimensions and the radius of gyration of the usual sections is given as follows:

CROSS SECTION.	$r^2 : h^2$.	$r : h$.	Comparative values of a for use in Gordon's Formula.
Solid Rectangle	$r^2 = \frac{h^2}{12}$	$r = \frac{h}{3.46}$	$\frac{1}{3000}$
Box Column	$r^2 = \frac{h^2}{6}$ approx.	" $= \frac{h}{2.45}$ approx.	$\frac{1}{6000}$
Open Col. of Channels	$r^2 = \frac{h^2}{7.3}$ "	" $= \frac{h}{2.7}$ "	$\frac{1}{4930}$
Solid Circle	$r^2 = \frac{h^2}{16}$	" $= \frac{h}{4}$	$\frac{1}{2250}$
Hollow (thin) Circle	" $= \frac{h^2}{8}$ approx.	" $= \frac{h}{2.82}$ approx.	$\frac{1}{4500}$
Phœnix Col.	" $= \frac{h^2}{7.6}$ "	" $= \frac{h}{2.75}$ "	$\frac{1}{4750}$
Cross +	" $= \frac{h^2}{24}$ "	" $= \frac{h}{4.9}$ "	$\frac{1}{1500}$
Amer. Co.'s Col	" $= \frac{h^2}{11.6}$ "	" $= \frac{h}{3.4}$ "	$\frac{1}{3100}$

The fractions in the second member of the equations, under the third column, represent the comparative lengths of columns of different cross sections of equal strength. For example, the relative length of a Phœnix column and an American Company's column of the same strength would be as $\frac{1}{2.75} : \frac{1}{3.4}$, or as 34 diams. is to 27½ diams.

This shows the importance of referring to the ratio of the radius of gyration instead of trying to compare by the ratio of diameters between columns of such unequal resisting capacity.

CORRESPONDENCE.

WHY IS IT?

The radius for a 1° curve is 5,729.65 ft., and the radius of a 10° curve is laid down at 573 69 ft. Why is not 572.97 ft., or rather, why is not 5,729.65 divided by the number of the degree for which one wishes to find the radius?

NIMROD.

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PERSONAL.

W. B. **KNIGHT** has been appointed City Engineer of Kansas City, Mo.

J. Q. **BEARD** has been appointed Chief Engineer on the Chicago, Goodland & Southern Railroad, now being built.

J. J. **SHIELDS** is Chief Engineer of the Atlantic, St. Johns & Indian River Railroad, headquarters at St. Augustine, Fla.

THOMAS GRAHAM, JR., is Chief Engineer of the new East River Railroad, with headquarters at Pearisburgh, Giles County, Va.

C. S. **MASTEN** has recently been made Division Engineer of the Western Division of the Wabash Railway, in charge of bridges and buildings.

AT the meeting of the Institution of Civil Engineers (London), on March 7, J. James R Croes, C. E., of New York City, was elected a member of the Institution.

COL. JAMES McCLURE, of Niagara, has been appointed Chief Engineer of the Buffalo, Tonawanda & Pine Creek Railroad, and will commence the surveys immediately.

MR. JOHN DUNN, for many years in the employ of the Illinois Central Company, and for some time Assistant Secretary, has been appointed Vice-Consul for Great Britain in Chicago.

MR. JOSEPH ROBINSON has retired from the firm of Benj. Pike's Son & Co., manufacturers of fine engineering, surveying and mining instruments, 928 Broadway, this city. The firm name will be continued as heretofore.

A Philadelphia dispatch of the 27th says: Rudolph Hering, the civil engineer of this city, left for Cleveland yesterday, where he has been engaged to make a critical examination of the sewerage system of that city. He will be absent two weeks.

ENGINEERING STAFF MEXICAN CENTRAL.—The following named are the officers of the engineering department of this road: Chihuahua Division, located at Paso del Norte, Mexico, Geo. W. Vaughn, Chief Engineer; C. G. Vaughn, Office Engineer; M. D. Parlin, principal Asst. Engineer; J. E. Cunningham, Chief Draughtsman. This list may be of assistance to some wishing to correspond with these officials. All mail should be addressed El Paso, Tex.

Under Necrology in the last annual catalogue of Rutgers College (1881-82) we find a notice of the late Benj. D. Frost, C. E., compiled by Prof. Hasbrouck from data furnished by a near relative. As it is an accurate and concise account of the many works accomplished by Mr. Frost we present it to our readers in full:

BENJAMIN D. FROST was born at Wayland, Mass., Aug. 10, 1830, and died at St. Louis, Mo., July 19, 1880. He was graduated in the class of 1845 with high rank. The following year he passed in a further course of liberal study as a resident graduate at Harvard University, Cambridge, Mass. At the conclusion of the year so spent, he commenced under Samuel M. Felton, a celebrated civil engineer, a course of study and practice in preparation for the profession of his choice. In 1850, while engaged in the office of the Chief Engineer of the Baltimore & Ohio Railroad, not then completed, his ability and fidelity so commended him to his chief that he was placed in charge of a difficult section of construction, known as the "Pettibone Tunnel." Then followed a busy life of professional work on the Alexandria, London & Hampshire Railroad, in Virginia; the Sunbury & Erie in Pennsylvania; in Maryland, Wisconsin and North Carolina. He was later employed on the Kansas City Bridge over the Mississippi River; in Central Park, N. Y. City; in surveys and studies for Prospect Park, Brooklyn, N. Y.; on the work preparatory to the construction of the aqueduct at Washington, D. C.; on harbor work at Boston, Mass., and in numerous minor undertakings of similar character. With the experience and skill thus acquired, he was selected as State Engineer of the Hoosac Tunnel, a work of national interest and importance. He continued in charge of this enterprise for eight years, until its completion in 1876. In 1879 he accepted his final commission from the United States Government, conducting the surveys of the Mississippi River. While engaged in this work he was attacked by the malarial disease prevalent in that locality, and in the midst of hope and high endeavor was suddenly lifted out of labor into rest.

His reputation among those of his profession was deservedly high; his name will remain forever identified with some of the greatest engineering problems of his country, while his memory will ever be honored by his superiors, to whom he was faithful, and by his subordinates, to whom he was always helpful and considerate.

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The following papers were published during the past year, some of which will be discussed at the Washington Convention:

CCXXII. (*June.*) Annual Address at Montreal, June 15, 1881: James B. Francis.

CCXXIII. (*July.*) The Re-enforcement of the Anchorage and Renewal of the Suspended Structure of the Niagara Railroad Suspension Bridge: L. L. Buck.

CCXXIV. (*July.*) The Flow of the Sudbury River, Massachusetts, for the years 1875 to 1879: A. Fteley.

——(*July.*) Discussion on Rainfall and Flow of Streams.

CCXXV. (*August.*) Comparative Economy of Steel Rails with Light and Heavy Heads: Ashbel Welch.

CCXXVI. (*August.*) Quicksand in Excavation: Charles L. McAlpine.

CCXXVII. (*September.*) Repairs of Masonry: O. Chanute.

CCXXVIII. (*September.*) Strength and Ductility of the Copper-Tin-Zinc Alloys: R. H. Thurston.

CCXXIX. (*October.*) Shaft Sinking under Difficulties at Dorchester Bay Tunnel, Boston, Mass.: D. McN. Stauffer.

CCXXX. (*November.*) Sewerage Systems: Rudolph Hering.

CCXXXI. (*December.*) On Uniform Standard Time, for Railways, Telegraphs and Civil Purposes Generally: Sanford Fleming.

CCXXXII. (*January*, 1882.) Experiments upon Phoenix Columns: Clark, Reeves & Co.

CCXXXIII. (*February–March*, 1882.) Discussions on Wrought-Iron Columns, Tests and Formulæ.

The following papers, not yet published, are also open for discussion. Proof slips of these will be prepared for issue as soon as possible:

A Note upon the recent Railroad Crossing Case at Elmira, N. Y., with reference to the hydraulic questions brought forward: William R. Hutton.

The Averaging Machine: W. S. Auchincloss.

On the Removal of Incrustations in Water Mains; a description of the operations performed in Halifax, N. S., Canada: E. H. Keating.

The Mean Velocity of Streams Flowing in Natural Channels: Robert E. McMath.

The Overflow of the Mississippi River: Lyman Bridges.

On the Mode of Underpinning adopted for the Croton Lake Bridge, New York City and Northern Railroad, during the Repairs of the Masonry Piers: Alfred P. Boller.

TESTS OF STRUCTURAL MATERIALS.

Note.—The following memorial has been prepared by the Board of Direction of the American Society of Civil Engineers under instructions of the Society in annual meeting, January 18th, 1882. It has been signed by the President and Secretary in behalf of the society, and presented to the Chairman of the Committee to which the bill to appoint a Commission of Experts to test Structural Materials (House Bill 4,726), has been referred.

John Bogart,
Secretary Am. Soc. Civil Engineers.

The Memorial of the American Society of Civil Engineers respectfully represents:

That pursuant to authority given by an act of Congress approved March 3d, 1875, the President of the United States appointed a Board to test the strength and other qualities of iron, steel and other metals, such as are used for constructive and mechanical purposes; that a testing machine, believed to be the best in existence, has been constructed and is now ready for use at the Watertown Arsenal; that the said Board made many tests and obtained much information of great value; that said Board expired by limitation of law, leaving much important work yet to be done.

And your memorialists further represent that it is of great importance to the public safety as well as to the economical use of materials by builders and manufacturers, and by the Government itself, that iron, steel and other materials, used in bridges, buildings and every kind of structure, should be carefully tested for the following among other reasons:

The tests of materials heretofore made, both in Europe and America, have commonly been of small specimens, from which, owing to the different circumstances of manufacture and shapes of the specimens, the strength, elasticity and other useful qualities of large specimens of the same materials cannot be accurately inferred, and therefore it is necessary to test those larger specimens, especially the members of bridges, buildings and other structures, of the sizes and forms in actual use. New processes of production of iron, steel and other materials have come, and are still coming into use, the products of which vary very considerably from the products of older processes, and it is therefore important, both for safety and economy, that they should be tested. The real margin of safety of any member of a structure is not the difference between its actual load and the load that would break it at once, but between its actual load and the heaviest load that would not practically impair its strength by overtaxing its elasticity. To ascertain this, particularly for the full-sized members of structures, requires the use of the largest and most accurate of testing machines by skillful experts, who should personally make these tests and investigations, and place the results in such a practical form as will serve as a safe guide to every person engaged in construction, or in the manufacture of materials for construction. The absence of reliable knowledge of this character has doubtless contributed to, if it has not been the sole cause of, some of the most serious failures of structures, otherwise in no respect faulty, whereby many lives and much property have been sacrificed.

From these and other considerations it will be seen that the public safety, as well as the economical use of materials by the Government and by builders, imperatively demand more thorough tests and on a larger scale than most of those heretofore made.

And your memorialists further represent that there is no prospect that the necessary tests will be made without the aid of Government. Should private manufacturers or builders test their own materials, they might not give the public the benefit of their experiments; such experiments would not have that assurance of impartiality and that high authority which those made under the authority of the Government would have. Experiments conducted by private parties would be so different in the objects, methods and circumstances of applying tests as to render it impossible to properly collate and verify them; they would, therefore, be of comparatively little value in ascertaining accurate general results.

Associations, such as your memorialists, have not the means to defray the expense of such investigations.

Wherefore your memorialists pray your honorable bodies to authorize the President of the United States to appoint a Commission from among men skilled in the investigation, production and use of metallic substances and other structural materials, who shall plan and execute the needed tests and experiments on iron, steel and other materials in extensive use in bridges, buildings and mechanical structures, and deduce useful rules therefrom.

And your memorialists further pray that such appropriation be made as may be required to improve, if necessary, the testing machine before mentioned, and as may be required to secure the services of experts of the highest ability and to pay the expenses of experiments.

A BILL.

Authorizing the President to appoint a commission of experts, skilled in the investigation, production and use of metallic substances and other structural materials, to execute tests and experiments on iron, steel and other materials, used in the construction of bridges, buildings and mechanical structures, and deduct useful rules therefrom.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

Sec. 1. That the President of the United States be and he is hereby authorized to appoint a commission of seven members selected from among men skilled in the investigation, production and use of metallic substances and other structural materials, to hold their appointment during the pleasure of the President of the United States; which commission shall plan and superintend the execution of such tests and investigations of materials used extensively in the construction of buildings, bridges, ships and other structures and machinery, as it shall think most important to be made, and from time to time publish results of the tests and investigations, and also such scientific principles and such practical rules deduced therefrom as it shall consider most useful. The said commission shall organize itself, and adopt such rules, and make such assignment of duties among its members as it shall deem most promotive of the object of its appointment. Vacancies occurring from time to time in said commission shall be filled by the President of the United States.

Sec. 2. That the said commission shall report its work with its results and the deductions made therefrom, annually to the Secretary of the Interior, and its accounts shall be settled in the Interior Department, through such channels as the Secretary shall direct.

Sec. 3. That the members of said commission shall be entitled to mileage and other necessary expenses incurred in the prosecution of their duties, but no salaries as members of the commission.

Sec. 4. That the said commission is hereby authorized to appoint a principal expert who shall personally conduct the examinations and tests which the commission shall direct, with such assistants and laborers as may be necessary, and also to purchase such material for test and investigation as may from time to time be required.

Sec. 5. That this act shall take effect immediately.

LIVERPOOL ENGINEERING SOCIETY.

The fortnightly meeting of this society was held at the Royal Institution, on Wednesday evening, Mr. F. Salmon, President, in the chair, when a paper was read by W. James Morgan, on the construction of Impervious Street Pavements, with special reference to the methods practiced in Liverpool. In introducing the subject, the writer stated that previous to 1872 impervious pavements had no existence in Liverpool, and although the late Mr. Newlands, in his published report to the Health Committee in 1848, strongly recommended on sanitary grounds the construction of pitch jointed impervious pavements. No action was taken for 24 years, when the carriageway on North John street was reconstructed. The obvious advantages of the system soon became so apparent that at the present time there are within the city not less than 650,000 superficial yards of impervious pavements, all laid within nine years by the workmen of the corporation. This work has mainly been carried out in business streets and leading thoroughfares, but the writer urged the importance of extending the system more generally to the back streets in the densely populated parts of the city, to the entire abolition of bowlder paving, with its filth holding joint. The writer then described in detail the construction of the various classes of pavements and concrete foundations laid in Liverpool, exhibiting specimens of the material used in the work. In referring to wood pavements the author remarked that, though the use of wood as a paving material has been strongly advocated of late years by tradesmen in busy thoroughfares, where the continuous din of city traffic is a great hindrance to the carrying on of their business, and a noiseless pavement would be a boon, yet want of knowledge and carelessness in its construction have prevented it from receiving the encouragement from engineers that it undoubtedly deserves, though next to macadam the most expensive pavement to maintain. Yet this excessive cost is counterbalanced by the comfort and quietness afforded in thoroughfares where these conditions are essential to the carrying on of business.

A discussion followed the reading of the paper, and on account of the interest and importance of the subject the discussion was adjourned till the next meeting of the Society, to be held on April 26.

A vote of thanks was accorded to the author for his interesting paper.

RECENT INVENTIONS.

ELEVATED WAY.

This invention consists of a car traveling upon a fixed cable arranged between two points. The cable is stretched between two suitable supports, and secured by a strap provided with rollers adapted to travel on a vertical frame secured to the supports. The cable is raised or lowered at either end by means of a cord passing over a system of pulleys and attached to the straps, and having at one end a weight, and at the other a shaft adapted to operate the device. This mechanism simultaneously changes the relative vertical positions of the ends of the cable, so as to cause the suspended car, by the action of gravity, to automatically pass from one end of the cable to the opposite one.

PNEUMATIC ELEVATOR SYSTEM.

This novel improvement contemplates a number of pneumatic elevators to receive their power from a common central supply of compressed air. The central station has an air-compressing apparatus, and one or more extensible and compressible air holders or reservoirs located thereat. Pipes convey air from the compressor to the reservoirs. A main conducts air away from the central station, to each of the outlying distant elevator stations. Each of these elevators is provided with an air engine or motor connected with the main air-duct, to operate the elevator. A pipe permits air, on the downward movement of the elevator, to escape, and this escape may be used for ventilating purposes, etc.

SUPPORT FOR FIREMAN'S HOSE.

This late improvement consists of a hook which is secured to a threaded ring surrounding the nozzle near its juncture with the pipe. This hook is adapted to engage the round of a ladder, and is held in position by a catch.

CHAIN PUMP.

This improvement consists in the novel arrangement and construction of a flexible lining within the bore. The chain-pump tube has the usual cylindrical bore. It is provided with a lining of rubber or other elastic or flexible material, so that a closed or water-tight space is interposed between the lining and pump tube to allow said lining to adjust itself to the unevenness of the buckets.

AUTOMATICALLY DUMPING AND RIGHTING ELEVATOR-BUCKET.

This improved hoisting-bucket suspended upon pivots on its opposite sides, located at such a point as to be above the center of gravity of the empty bucket and below the center of gravity of the loaded bucket, whereby the loaded bucket, when released from its latching devices, will automatically dump and empty itself, and when emptied the bucket will automatically return to and latch itself in an upright position.

RAILWAY SWITCH OPERATING DEVICE.

In this improvement the switch-operating rod which extends to the distant lever carries guides, through which slides the switch-operating bar. A hand lever is pivoted to the bar, and to links secured to the guides, whereby the switch may be operated independently of the distant lever. To prevent restoring the connection when the switch is wrongly set, a chain with a securing padlock is employed. When being operated by hand the weighted hasp falls in front of a stop-plate and prevents movement by the distant bar.

ROAD LOCOMOTIVE.

This locomotive, for ordinary roads, consists of a boiler supported upon a front pilot wheel and rear driving wheels. The cylinders are secured to the underside of the boiler, and the crank or engine shafts work pinions which mesh with gears on the drive wheels. The pilot wheel is supported upon a saddle, recessed on its edge and fitting into a ring secured to the boiler, and is operated by a rod and lever connection from the cab.

Washington, D. C. F. B. Brock.

IMPROVEMENT OF THE MISSISSIPPI.

The minority report of the Mississippi River Commission, prepared by Captain James B. Eads, was obtained from him by a *Tribune* reporter on the 24th. The report has just been completed and has not been published. Captain Eads dissents from the recommendation of the majority report for the construction of a sill to interrupt communication between the Mississippi and Atchafalaya rivers. He urges the immediate construction of a sill in the Atchafalaya, near its upper end, to diminish the volume of water flowing through that outlet, and from year to year, as rapidly as may be deemed safe, the building up of the sill until it shall finally constitute a dam, completely separating the river from all communication with the Red and Mississippi rivers. The result of this will be, he says, to increase the volume flowing in the main river and improve the depth of water on bars below the Red River, on which, at low water, there is now only a depth of ten feet. The minority report also opposes the proposed improvement of the harbor of Vicksburg by reveting Delta Point against further erosion, and by dredging out a basin and a channel leading to the harbor, by which steamers will have access to Vicksburg landing. He favors an artificial extension of Delta Point to a sufficient distance to throw the channel against the old landing at Vicksburg. "Approximate estimates made by me," says Captain Eads, "show that this can be accomplished for $1,200,000 and deep water permanently secured at the Vicksburg wharf without further outlay for maintenance. Two hundred and fifty thousand dollars could be profitably expended upon this work during the ensuing year."

The main part of the minority report, however, is devoted to advocating the immediate closing of the present gaps in the Mississippi River levees, as an important factor in the contemplated plan for the improvement of its low-water navigation. Observations made by the Commission, Captain Eads holds, plainly show that these gaps have had the effect of raising the river's flood-line many inches above any height previously attained within the 700 miles in which they exist most numerously, between Natchez and the mouth of the Ohio. The deposits from the crevasses have raised the bed of the river so much as greatly to injure navigation. Captain Eads describes at length the physical formation of the lower or main alluvial basin of the Mississippi, and the land-building process resulting from the deposits of sedimentary matter when the river at flood tide escaped over the banks of its channel. The loss of current in the water thus escaping caused the sandy or heavier parts of the solid matter held in suspension in it to settle almost immediately on the submerged banks, while the argillaceous and lighter parts, taking longer to settle, were carried back by the feebler current to the swamps or lower lands, on which they were deposited over a much more extensive area. As the loss of volume over the natural banks produces a more sluggish current in the main channel, thereby causing a greater deposit of sediment, the bed of the stream, as well as the banks, was built up higher and higher during each successive flood. Occasionally the conditions were such as to cause the stream to forsake entirely its old channel, and the elevation of its banks and bed above the adjacent lands enabled it to send its earthy matters many miles away, so that every part of the basin was covered with its deposits.

Captain Eads' report says in substance that levees, by restraining the floods within the defined channel of the river, stop the land-building process. It is an error to suppose that rivers confined by levees have a tendency to have their beds elevated and in consequence to need a corresponding elevation of the levees. Three principles control the phenomena of sedimentary streams flowing in channels made through their own deposits—first, the force producing the current, resulting from a fall from a higher to a lower level; second, the frictional resistance of their beds; third, the dependence of the quantity of sediment carried in the water upon the velocity of the current. The normal velocity of a current cannot be permanently increased by man. By securing a higher velocity of current from the retention of the whole volume of water within the levees, a greater amount of sediment will be transported. If that amount is greater than that which the tributaries contribute, it will be taken out of the bed to the benefit of navigation, and the flood line consequently will be lowered to such a degree as will finally reduce the excess of current which the increased volume has produced down to the normal velocity. The increase of volume which will be secured by the closing of the gaps in the levees will produce this increased current. The report contains the results of many observations and careful measurements of the Mississippi during the floods of 1851 and 1858. They prove, in Captain Eads' opinion, that it is entirely practicable to retain the entire flood discharge of the river within the present levees, if they are repaired, even without making them any higher. If the gaps are left open, he says, "new shoals and injurious changes in the channel will be occurring at other points of the river than those selected by the commission for immediate improvement, and these new obstructions and changes in the channel will require so much more additional work, and this will undoubtedly cost twice or thrice as much as it will to repair the levees. By repairing them the channel will not only be prevented from becoming worse at any point on the river, but the shoaling which has occurred as a result of these outlets will be removed by the effect of the levees, and the work of improvement can then be limited to the reduction of the excessively wide places which now exist and which are inclosed by the present levees. These wide places are the cause of cut-offs, caving banks, shifting channels and vexatious shoals."

USEFULNESS OF ENGINEERS' SOCIETIES.*

* * * I am a firm believer in the usefulness of such organizations. People devoted to kindred pursuits have naturally much in common, and such a society brings them together, not only professionally, but socially. It is the good fortune of our calling that there is not much personal rivalry or competition. The field is so large and capable of such great subdivision into specialties that there is room for all; and so the relations of practical engineers are rarely complicated by personal misunderstandings. At the same time each one, working in his own field (and the working engineer is always a busy man), is rather isolated from his brethren engaged in differing, but yet kindred pursuits. Such an organization as this brings them together occasionally, and so professional sympathies may ripen into personal and congenial regard and friendship. Doubtless, no one goes away from these meetings without feeling that the time has been pleasantly as well as usefully spent. But, after all, the great service is probably professional. Here are many bright and eager minds, devoted earnestly and laboriously to the various branches of the broad science of engineering. Each relates his special experience, nothing in which can fail to be of interest to all; and in the conversations and discussions which follow there is always substantial and suggestive nutriment. No profession is so widely subdivided as ours. In its broad sense, it is the *science and art of construction*, and so incloses within its ample limits a multitude of specialties, related and yet differing, connected and yet distinct; and any one of these specialties demands and must receive the best industry and ability of him who would worthily practice it. Rennie built docks, bridges, canals, light-houses, sewers, mills, and undertook mining and metallurgy. At the present day each of these branches has its own disciples and students. One mind cannot grasp so great a field; it is enough to be thorough in one sub-department.

And such a society as ours brings all together, and each one can learn from and profit by his neighbor. Surely, its motto might be "E Pluribus Unum."

To be called to the presidency of such a society is an honor to any one, and as such I gratefully accept it.

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*From address of Willard S. Pope, President of the Western Society of Engineers. Reprinted from Journal of the Association of Engineering Societies.

SALT WITHOUT SAVOR.

The riddle which every man in the world tries to guess is, What is the secret of success? Why does ill-luck dog one man, who is not only good-looking and attractive but honest and hard-working, while a tricky, vulgar fellow with a plebeian brain, gains reputation, happiness and fortune? What peculiar quality is it in a man which enables him to get whatever object he sets before him as best worth having? Our middle-aged reader out of his experience can tell us that it is not genius which brings down the big prizes of life; nor talent and sharpness, however skilfully trained, the man born to money or influence does not always succeed, neither does the patient drudge, however hard he strive. Faith in God or the lack of it does not seem to affect the matter at all. He does not invariably reward His disciples with the fulfillment of their own pet plans; now it is the saint who is ahead in the race at college or in the world of trade, literature or society, and now the sharper. You cannot gauge a man's religion by the amount of his popularity or bank stock.

What is it, then? What is the secret which some men possess which forces difficulties out of sight and compels better and cleverer men than themselves to work for them; serve as rungs for their ladder to fortune? We think it will be found that all successful men have one peculiar trait in common. Each has had only a single aim in life, and has pursued it with an inexorable intensity of purpose, regardless of outside issues or consequences. In proportion as the aim is limited and in proportion as the whole man is absorbed in his direct purpose, he is likely to succeed. His object may be the preaching of the gospel, it may be the selling of a patent plough, it may be a great heroic truth or a gigantic swindle, but if he believes in it absolutely, if he shoulders it with fiery zeal, he will as a rule carry it through and compel other men to believe in it and shoulder it too; while if he lags along, half-hearted, uncertain, doubting it and himself, he and his cause will fall by the way.

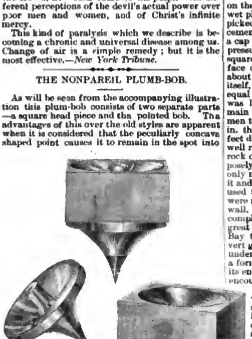
Now every genuine young man begins his career with a flash of this hot live faith in his own business in the world. It may be a trade or profession, or a hobby or reform, or the greatest cause of all, the serving of Christ; but to him it is the one real thing that he knows. It is the life-saving boat and he is the pilot; it is the bridge just built across Niagara, and he is the engineer. But by the time he is forty the flash has died out. He begins to see that there are more pursuits in the world than one; the energy which, when pent in one channel by the intolerant bigotry of youth, flowed like a mountain torrent, oozes now through a thousand openings, broad, shallow and sluggish. Or he grows selfish; why should he risk his comfort and life in saving other people? It is enough for him to take care of wife and children without manning life-boats or building bridges over Niagara. With most of us, however, our occupation or errand into the world has lost interest and zest for the commonplace reason of too great familiarity. Ninety-nine out of a hundred of the men and women who crowd Broadway are in some kind of a rut, and a rut, like the tracks of the street-cars, though it makes pulling easier for the horse, is apt to return on itself; it leads nowhere. This is why the middle-aged doctor or lawyer jogs through his work without honor or profit; all he asks now of the noble profession which fired his ambition at first is to pay his bills. His pleasures lie outside of it, in his club, in art, in his dinner. This explains why, when artists or authors meet, "shop" is so often talked instead of the great truths which outsiders would expect to hear in a convocation of seers. This is why so many clergymen preach Sunday after Sunday dreary platitudes which drive men out of the pews and leave only the women, whose devotion is ardent enough to inform the dead words with life to their souls. It is not that his profession, his art or his religion is not dear to each of these men; but he is no longer in love with it. His brain is tired of looking at it closely. It has grown commonplace and dull to him. The salt has lost its savor. Hence it comes that the artist, the professional man, the clergyman, though they work far harder than at first, do not succeed. There is something lacking in the book, the picture, the sermon; it is without leaven; the world does not want it.

Now, how is this man to put life into his work again? The most sensible thing which a man can do, when his work grows to be only a load to be hauled in a rut, is to get out of his rut, step aside from it long enough to look at it with a stranger's eyes. It is the middle-aged man more than the boy who needs the long journey to California; to Europe, anywhere among new habits and new peoples. If the artist or author would turn his back on his comrades and scramble on to some other level in life than that of his own trade, he would better see the possibilities of his work. If the clergyman would sometimes shut up his study, lay off his white cravat and all the prerogatives of his office, and go down and jostle and be jostled in the crowd, he would come to his pulpit with different perceptions of the devil's actual power over poor men and women, and of Christ's infinite mercy.

This kind of paralysis which we describe is becoming a chronic and universal disease among us. Change of air is a simple remedy; but it is the most effective.—*New York Tribune.*

THE NONPAREIL PLUMB-BOB.

As will be seen from the accompanying illustration this plum-bob consists of two separate parts—a square head piece and the pointed bob. The advantages of this over the old styles are apparent when it is considered that the peculiarly concave shaped point causes it to remain in the spot into which it is dropped, and prevents it from waving in any direction. The square top keeps it steady and stationary along any wall or other perpendicular place to which it may be applied. The bulged or convex sides of the old patterns divided the weight of the bob so unevenly as to cause its point to move on the slightest change of position or touch, and making it difficult to steady the instrument wherever suspended.



The "Nonpareil" has been lately introduced by Messrs. Keuffel & Esser, of this city.

CONNECTICUT LEGISLATION.

The General Railway law of Connecticut has been amended by the General Assembly, just adjourned *sine die*, so as to make its provisions more liberal in several respects. The time for taking land has been extended from one to two years, and navigable waters may be bridged with the consent of the Railway Commissioners without an application to the General Assembly. The bridging of the Thames River at New London, which promised to be a hard fight, was adjusted by the passage of a bill leaving the whole matter to be determined by a Board of Engineers to be appointed by the War and Navy departments. The hottest fight of the session was over the charter of a parallel road between New York, New Haven and Boston; but the bill was defeated in the Senate after its passage by a large majority in the House. The New York & New England road has been given five years additional time for completing its lines, and has been authorized to issue $5,000,000 of bonds, and the Connecticut Western has been empowered to purchase or lease the Rhinebeck & Connecticut road, connecting with its line at Millerton, and giving it important control of freight business and passenger traffic from Hartford westward.

BRICKWORK UNDER PRESSURE.

During the construction of the tunnel under Dorchester Bay in Boston, it became necessary to construct a brick bulkhead that had to withstand the pressure due a water column 162 ft. high, and, as it was intended to shut off a leak amounting to 240,000 gallons per 24 hours, it had to be watertight. Mr. D. Stauffer gave the following description of this work before the Engineers' Club of Philadelphia:

The tunnel section at the point selected for the bulkhead was practically 10 feet square. The bulkhead was built directly across the tunnel, 50 feet in front of the heading where the water was struck. Plank dams filled with puddle clay were first thrown across the tunnel, each side of the bulkhead site, and a 6-in. wrought-iron pipe used to carry off the water during construction—the pipe being built into the brickwork. An arched form was adopted, 4 ft. thick at the crown and 2 ft. rise in a span of 10 ft. Hard-burned bricks were used, laid in mortar made of one part English Portland, one part Newark Rosendale, and two parts clean, sharp sand—a compound found equally strong with English Portland, and sand one to one, and having the advantage of working smoother on the trowel, and adhering better to brickwork in wet places. Skewbacks for the arch were roughly picked out in the rock at the sides. After the cement had set, the water was shut off by screwing a cap on to the outer end of the 6-in. cap. The pressure against the wall was 72$\frac{1}{16}$ lbs. per square inch, or about 519 tons distributed over the face of the bulkhead. The wall was tight for about 48 hours; then water came through the *brick* itself, rather than through the joints, in amount equal to one half the original volume. The water was let off and a second experiment tried. The main wall was torn down sufficiently to allow men to pass behind it, and a second wall only 12 in. thick was built back of the first, and two feet distant. The space between these walls was well rammed with puddle clay, extending to the rock on all sides. The second wall was made purposely light, as its yielding to the pressure would only more effectually consolidate the clay between it and the unyielding wall in front. The bond used in the main wall was one so laid that there were no continuous horizontal joints through the wall. The result of the last construction was to completely shut off the water from this leak, at a great saving of fuel and pumps. The Dorchester Bay tunnel is 7,000 ft. long, with its average invert grade 148 ft. below low-tide mark in the bay under which it passes. The tunnel is driven through a formation of clay, slates and conglomerates for its entire length; rock, very seamy, and much water encountered.

We may add that in mining bulkheads, which often must carry much greater pressures, the practice is to let the water rise slowly behind the bulkhead, by allowing a portion of the water to flow through a safety-valve at the bottom of the level. It has been the experience in all such cases that in the beginning quite a quantity of water will come through the pores of the brickwork, which is said to be "sweating." Gradually, however, the pores are filled by carbonate of lime, and a thick coat of that substance forms on the face of the bulkhead, completely cutting off the entire flow of water. A column of from 400 to 500 ft. has been borne for many years by such bulkheads.—*Engineering and Mining Journal.*

FLORIDA NOTES.

The Live Oak, Tampa & Charlotte Harbor Railway Company will build a branch to their main line from Suwannee County to Gainesville.

The Florida Central & Western Railroad Company has filed articles of incorporation. The road will run from Jacksonville to the Apalachicola River, with a branch from Tallahassee to St. Marks, and from Drifton to Monticello, all in the State. The road will be 23.4 miles long.

The Chattahoochee & East Pass Railway Company has been incorporated. The road will be about 65 miles long, and will be constructed between a point at or near Chattahoochee, in Gadsden County, to the waters of the Gulf of Mexico, at some point on the southern boundary lines of Franklin County, between the eastern and western boundary lines of said Franklin County, and will pass through or into the counties of Gadsden, Liberty and Franklin.

The incorporators and builders of the Southern Railroad, leading to Palatka and Gainesville and southward, have filed articles of incorporation in Tallahassee for the purpose of building a road from Palatka to St. Augustine.

The *Tampa Progress* of the 27th ult. said: "Last week was quite an interesting one in railway affairs in Tampa. The return of the engineer corps of the Jacksonville, Tampa & Key West, after completing their line of survey to Punta Rassa, and on the same day the engineer corps of the Live Oak, Tampa & Charlotte Harbor Railway camped at Two-Mile Branch, and several of the party came into town. They had completed their line to Gasperilla Island, and came back highly pleased with their route. Then on Friday the right-of-way party returned, having gone some 40 miles along the route of the Jacksonville, Tampa & Key West Railway, and secured the right of way without any material difficulty or obstacle presenting itself."

The Orange County papers notice the incorporation of several new companies. One is a company to construct the Apopka branch of the South Florida Railroad. This branch of railroad will be about 58 miles in length, and will be constructed from a point at or near Jackson's, on the main line of the South Florida Railroad, to a point on the Withlacoochee River, passing through the counties of Orange and Sumter. Another is the Kissimmee, Okeechobee & Gulf Navigation Company, its principal place of business at Sanford. The general nature of the business to be transacted by this company is the purchase, construction, operation and navigation of steamboats, steamships, barges and all manner of steam, sailing and other crafts on the Kissimmee River, Lake Okeechobee and Caloosahatchie River, to the Gulf of Mexico. Another company, to be known as the Suwannee & Santa Fe Railroad Company, will build a road from a point at or near Melrose, in the county of Clay, in said State, into or through the counties of Alachua and Lafayette, to some feasible point on the Gulf of Mexico, in said State of Florida. Still another road has been incorporated to build a road from Titusville, in Brevard County, on the Indian River, to Bartow, thence to Fort Meade, in Polk County, and thence to a point at or near the mouth of the Manatee River, in Manatee County, a distance of 150 miles.

Messrs. Palliser, Palliser & Co., of Bridgeport, Conn., have submitted plans for a court-house at Pensacola.

The city council of Jacksonville has passed an ordinance to regulate sewerage.

CONTRACTS FOR LIGHTING THIS CITY WITH GAS AND ELECTRICITY.

Mayor Grace, Controller Campbell and Public Works Commissioner Thompson, comprising the Gas Commission, met in the Mayor's office recently and awarded the contracts for lighting the city during the year, beginning on May 1. It was decided to light the Battery Park, City Hall Park, Broadway from Canal street to Fourteenth street, Washington square, and Fifth avenue from Washington square to Fourteenth street, with electricity, and a contract for that purpose was awarded to the United States Electric Light Company at the rate of 70 cents a lamp per night. It will take about 65 lamps to light the district. The Brush Electric Light Company was given a contract to light Broadway and Fifth avenue from Fourteenth street to Thirty-fourth street, Fourteenth street from Fourth avenue to Fifth avenue, Thirty-fourth street from Broadway to Fifth avenue, and Union and Madison squares. The price agreed upon was 70 cents a night for each lamp. The company is now lighting the same districts for 33½ cents a lamp. The Brush Company put in a bid to light High Bridge for $1 a lamp, but it was rejected because of the strenuous objections made by Controller Campbell. Other contracts were awarded as follows: New York Gas-Light Company, for the district south of Grand street, $17.50 a lamp per year; Manhattan Gas-Light Company, district between Grand and Thirty-fourth streets, $17.50 a lamp; Mutual Gas-Light Company, certain streets between Thirty-fourth and Seventy-ninth streets and the parks south of Thirty-fourth street, $17.50 a lamp; Metropolitan Gas-Light Company, district between Thirty-fourth and Seventy-ninth streets, $17.50 a lamp; Harlem Gas-Light Company, district north of Seventy-ninth street and south of Spuyten Duyvil Creek and the Harlem River, $19.50 a lamp; Central Gas-Light Company, Twenty-third Ward, $29 a lamp; Northern Gas-Light Company, that part of the Twenty-fourth Ward formerly the village of West Farms, $32 a lamp; Yonkers Gas-Light Company, the remainder of the Twenty-fourth Ward, $30 a lamp.

HANNIBAL, TERRE HAUTE & INDIANAPOLIS RAILWAY CO.—The survey of this road lately ordered by the corporators, under the leadership of the President, George M. Edgerton, and the Treasurer and Secretary, D. M. Edgerton, of St. Louis, has been in progress for some weeks, conducted by W. T. R. Fennessey, as Chief Engineer, and J. B. Moulton, Consulting Engineer. It traverses a southeasterly course, from the Hannibal Bridge over the Mississippi River, through the counties of Pike, Green, Macoupin and Montgomery, stopping for the present at Pana, in Christian County, Ill., where it will intersect the Illinois Central and the Illinois & St. Louis railroads, 94 miles from St. Louis. In Pike County it crosses the Louisiana Branch of the C., B. & Q. Railway and the Louisiana branch of the Wabash. In Green County it will cross the Jacksonville branch of the Chicago, Alton & St. Louis Railroad. In Macoupin County it will cross the main line of the last-named road and the newly-constructed St. Louis, Jerseyville & Springfield Railroad, now in the Illinois Wabash system. Length of road to Pana, about 125 miles. As soon as the right of way is secured from Roodhouse to Pana, construction will be commenced. The country this road passes through is not surpassed in farm products in the great State of Illinois, and its direction makes a valuable cut-off in the direction of Kansas City.

THE MISSISSIPPI RIVER APPROPRIATION.

The Senate has passed the Mississippi River Improvement Bill. It directs the Secretary of War, with the advice and under the direction of the Mississippi River Commission, to expend $6,000,000 ($5,000,000 on the Mississippi and $1,000,000 on the Missouri) in deepening the channels and improving the navigation of these rivers in accordance with plans recommended by the commission,

THE CURRENT METER OF PROFESSOR A. R. HARLACHER.*

Every one who has had occasion to measure the velocity of water in rivers or tidal currents has complained, and with reason, that the instruments in use for that purpose are inconvenient, and do not give results scientifically satisfactory. With Woltman's current meter, which has been chiefly used, the operation of determining the velocity is delayed and rendered laborious by the necessity of removing the meter from the water for every reading of the number of rotations. Nevertheless, this instrument is the only one which can be used in large and deep rivers. One cause of the inaccuracy of the results obtained by this instrument is that considerable time is required to determine the velocity at different depths in any vertical section, and a still longer time to repeat the operation at a sufficient number of verticals to give a good value of the mean velocity at the cross section. In most cases the level of the water-surface varies during the operations, and thus the different velocities are not ascertained under the same conditions, and cannot agree accurately with each other. Some engineers, therefore, have tried to shorten the time required for such measurements, by improving the method of counting the rotations of the meter. Thus Mr. Ritter (Engineer-in-Chief Ponts et Chaussées), at Paris, in 1859, and Mr. Henry, when measuring rivers flowing into Lake Erie, in 1867, adopted a method for electrically registering the number of rotations of the meter, and dispensing with the necessity for lifting it out of the water for each reading. Mr. Ritter, especially, took great pains to improve the current meter in this way, but arrived at no satisfactory results. Professor Harlacher, of the Technical High School at Prague, was the first to construct a current meter which obviates all the difficulties and drawbacks of the instruments previously employed. The Harlacher current meter permits the velocity to be determined in the shortest possible time. Before describing the details of the instrument a general statement may be given of its merits and advantages.

The current meter is a screw meter on the same general principle as the old instrument of Woltmann. Connected with it is an indicator, or clock, actuated electrically, which shows the number of rotations of the screw. The meter is suspended in the water by a cord so that it can be raised or lowered at will. It can therefore be *readily* placed at any depth or allowed to descend *slowly* and uniformly from the surface of the water to the bed of the river. The instrument is never taken out of the water until the measurements in one vertical of the section are completed, because the electric registration of the rotations is affected above water. When the mean velocity at one vertical is required, that is most easily obtained by allowing the meter to descend regularly and slowly along that vertical from the surface of the river. The number of rotations on the electric indicator and the time are noted. Dividing the rotations by the time, the mean rate of rotation of the meter, corresponding to the mean velocity of the stream, is found. The result is identical with that obtained, more laboriously, by measuring tha velocity at a number of equidistant points on the vertical and taking the average of the velocities. It is therefore needless, in future, to adopt the time-wasting method of observing a number of velocities at different points in each vertical in the cross section of the stream. It is only necessary to allow the meter to descend once along each vertical from the water surface to the bottom. Thus the whole of the measurements for a cross section can be completed in as many minutes as hours would have been required with the old form of the Woltmann meter, and the results will be more reliable, because for so short a time the general conditions of flow of the river will have remained constant. Variations of velocity due to variation of the level of the river are virtually eliminated when the Harlacher meter is used.

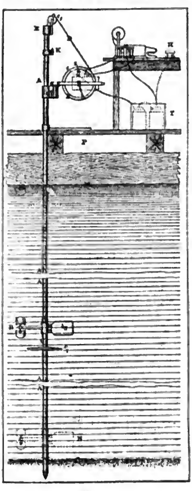


FIG. 1.

It is unnecessary to describe all the stages in the invention of the present form of the Harlacher meter. It is sufficient to say that Professor Harlacher worked for several years at its improvement, and that his success was acknowledged by the award at the Paris Exhibition of two gold medals.

The Harlacher meter is constructed as follows: For the movable staff on which the Woltmann meter is fixed, an immovable staff or rod is substituted, which is planted firmly in the bed of the river, and along which the meter slides up and down during the observations on any one vertical. This rod is a cast-iron tube with a solid point at the lower end *A*, *A* (Fig. 1). The other parts of the apparatus, except the electric battery and indicator, are fastened to the tube, so that the whole can be moved from one vertical to another, without having to be taken apart. The screw of the meter *B* is two-bladed. For very small velocities it would be preferable to adopt a four-bladed screw of larger diameter. The screw is fixed on a steel shaft *b* (Fig. 2) which has an eccentric enlargement at any point b_2. This makes contact with the steel spring b_4 at each revolution of the meter. These contacts complete the electric circuit, and the current which passes actuates the electric clock or indicator. The weight of the screw *B*, the shaft *b* and the brass box b_8 which carries the shaft, is balanced by a counter-weight b_3 (Figs. 1, 2 and 3). This keeps the axis of the instrument in a perfectly horizontal position. The screw b_6 serves to regulate the pressure of the spring b_4, while the two screws b_7 fasten the spring to the brass frame which surrounds and protects the shaft. The shaft is square at the end which receives the screw, which is put on and held fast by a nut b_9 (Figs. 2 and 3). The brass frame b_1 is fixed to a hollow cylinder *C*. Below the hollow cylinder *C* is a plate C_1 (Figs. 2 and 3), which prevents the instrument approaching too closely to the bed of the river, where it might be injured or retarded by obstacles. In the interior of the cylinder *C* there is a cylindric case e_2 (Figs. 3, 4 and 5), in which a brass spring is fastened, and through which the pin e_3 is carried. To this pin the end of the suspending rope *D* is fastened. The internal diameter of the cylinder *C* is a little larger than the outside diameter of the hollow rod *A* on which it is to slide. The part e_2 to which the rope is attached is connected with *C* by an arm which passes through a vertical slit in the hollow rod *A*. Thus, the instrument is kept always, if the pipe *A* is properly placed with its axis normal to the plane of the cross section. The cylinder *C* is also fitted with rollers e_5 e_6, which renders the motion of the fixed rod easy. After the instrument has been placed on the rod or staff, a bracket *E* (Fig. 1) with a pulley e_7 is attached at tha top, and the rope is carried over this pulley. The rope *D* is wound on a barrel *F*. This barrel is fixed with the frame f_1 and the pin f_2 on the arm *G* (Figs. 1, 6 and 7), which is firmly fastened to the hollow rod *A*. With the barrel is connected the apparatus f_3 registering the depth at which the meter is at any moment. The fan f_4 and gearing f_5 regulate the rate of rotation of the barrel and permit the adjustment of the speed of the meter in its descent along the rod *A*. By the handle f_6 the meter is again raised. The lever f_7 and ratchet wheel f_8 (Fig. 6) arrest the rotation of the barrel. The movement begins as soon as the ratchet is lifted by tha lever. On the frame of tha barrel *F* are fastened the contact screws 1, 2, 3 (Figs. 1, 6 and 7), for attaching the wires of the electric circuit. Tha screw 1 is connected with the rope *D*, which is a copper-wire rope, covered with insulation material. The rope is in electric contact with the shaft of the screw through the spring C_2,

FIG. 2.

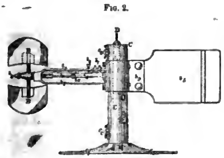


FIG. 4.

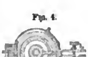


FIG. 3.

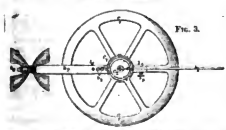


FIG. 5.

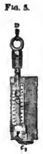


FIG. 6.

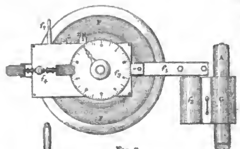
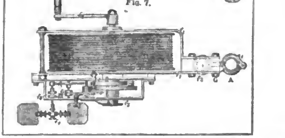


FIG. 7.



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* By Richard Blum, City Engineer, Leipzig. From selected papers of the Institution of Civil Engineers.

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(Fig. 5), because an insulated wire C_7 (Figs. 5 and 8) connects the lower end of the pin C_8 and the loop of one of the screws b_7 (Figs. 2 and 8), which fasten the spring to the brass frame b_8. The other conductor is the cast-iron pipe *A* which is in contact with the rest of the apparatus through the parts *C*, *G*, f_1, f_2, and *F* (Figs. 6 and 7). These parts are connected with the screw 2 (Figs. 1, 6 and 7). By putting a wire into the loop of screw 3 the depth of the meter below the water-line can be registered electrically. The registering apparatus *H* (Fig. 1) has two dials, one marking single revolutions and the other hundreds of revolutions.

If desired, a recording arrangement can be added, the rotations of the meter being marked on a slip of paper in the same way as in a writing telegraph or chronograph. Prof. Harlacher used this arrangement in determining the variation of velocity at a given fixed point. The battery *I* and the clock, or indicator *H* with the rod *A* carrying the meter, are placed on a float *P*. The sight vane *K* is fastened to the rod *A* so that it is parallel to the plane of the cross section, and then the axis of the screw is normal to the cross section and parallel to the current. The float is anchored in large rivers and fastened to guide ropes or poles in smaller streams. As soon as the work at one vertical of the cross section is finished, the anchor ropes on one side are slackened and on the other tightened, so as to bring the float into a new position in an easy and a speedy manner. The float must be built so as to be capable of supporting four or five persons.

The determination of the mean velocity at one vertical, by allowing the meter to slide once from the surface of the stream to the bottom, is accomplished thus: The meter *B*, and all its connections *C*, *c*, etc., are brought to within a few inches of the water surface, the fingers of the electric clock being set at zero. Then the barrel *F* is released by the lever f_1 (Fig. 6). As soon as the axis of the screw touches the water surface a signal is given, the electric clock is brought into the circuit by a spring lever, and begins to count the rotations of the screw. It is necessary to commence with the meter some small distance above the water surface in order that it may acquire the proper descending velocity previous to the counting of the rotations. In a certain number of seconds the meter descends from *M* to *N* (Fig. 1), having at each point in its descent acquired the velocity of rotation corresponding to the velocity of the water at that depth. Dividing the number of revolutions by the number of seconds, the rate of rotation corresponding to the mean velocity at that vertical is found. The fact that the disk e_1 (Figs. 1, 2, and 3), prevents the meter from descending exactly to the bottom, entails a small correction. This correction, however, will be more insignificant the larger the difference of the heights *MN* and *NO*, that is, the deeper the river in which the observations are made. It is a matter of course that the readings of the instrument at each vertical should be repeated, and the average of the results taken for the true mean velocity. The results of single measurements will not differ much from each other, but the repetition of the readings will give a certainty that all the variations of the velocity at the given vertical are allowed for.

Before using the meter, its contents must be determined in the same manner as with the Woltman apparatus. A length is marked out in a still-water basin, and the meter is frequently moved through this distance at different speeds. It is essential that the movement of the boat or float on which the meter is fixed should be a uniform one.

The above description of the apparatus will prove that the advantages of this form of meter are of considerable importance. Before the author was satisfied that the mean velocity in one vertical could be determined by a single observation, in the way described above, he made numerous experiments. The velocity was ascertained by allowing the meter to descend through the water, and also by observing the velocities at equidistant points on the vertical and taking the mean. The results of the two methods differed only in the fourth or fifth decimal place.

The Harlacher meter may be employed in large and deep rivers. The inventor has used it in the Elbe and Moldau rivers in Bohemia; in the Danube, near Vienna, and in the Seine, at Paris. The time required for the measurements is very short. The author has, at various times, made observations in the sewers of Leipzig, and in the four small rivers which flow through it, to ascertain the amount of pollution occasioned by sewage. In the year 1878 an officer of the government measured the flow in a mill channel, part of one of these four rivers, with a Woltmann meter. It took seven hours to record the necessary results. In the author's investigations on the four rivers, at points lying at an extreme distance of 3,000 yards apart, twelve hours were required, when determining the mean velocity both by allowing the instrument to slide down through the water, and by noting the velocity at every 2 inches of depth. For those observations in which the mean velocity was determined by allowing the meter to descend through the water only, six hours and a half were required for the four rivers, the measurements being repeated at each vertical three to ten times, according to the velocity of the stream. Further, the transport of the float from one cross section to another occupied in all about one hour of the time given above.

Prof. Harlacher has described his meter in a treatise* which can be recommended to every engineer interested in these questions. This treatise contains the measurements made in the Danube in 1878. The drawings of the meter are taken from this work.

APPENDIX.

The formula used with the Harlacher meter for determining the velocity of the water *v* from the observed number of rotations per second *n*, is [1]—

$$v = \alpha + \beta n,$$

where α and β are constants which must be determined by preliminary experiments with the meter in still water. The meter is towed over a measured distance in still water at different speeds, the speed in each trial being, however, as uniform as possible. The number of rotations of the meter, and the number of seconds occupied in traversing the distance, are observed accurately.

Let *m* be the sum of the number of seconds occupied in all the trials divided by the number of trials.

v the velocity during any trial.

n the number of rotations in any trial in one second.

$\Sigma (n^2)$ the sum of the squares of the values of *n*.

Σn^2 the square of the sum of the values of *n*.

$\Sigma v n$ the sum of the products of the corresponding values of *v* and *n*.

Then by the method of least squares—

$$\alpha = \frac{\Sigma n^2 \Sigma v - \Sigma n \Sigma n v}{m \Sigma n^2 - \Sigma n^2},$$

$$\beta = \frac{m \Sigma n v - \Sigma v \Sigma n}{m \Sigma (n^2) - \Sigma (n^2)}$$

Example.—Observations for determining the constants of meter No. 1. The meter was moved in still water through a distance of 102.5 meters.

Number of observations.	Number of revolutions registered by the electric clock	Time in seconds.	Velocity in meters per second. *v*.	Revolutions in one second. *n*.	n^2.	$n v$.
1	235	115	0.890	2.043	4.174	1.818
2	232	116	0.890	2.000	4.000	1.790
3	232	113	0.907	2.053	4.215	1.862
4	231	130	0.788	1.776	3.154	1.399
(5)	234	105	0.976	2.228	4.964	2.174
6	236	113	0.907	2.088	4.359	1.893
7	229	121	0.847	1.892	3.579	1.602
8	230	125	0.820	1.824	3.327	1.496
(9)	222	148	0.692	1.500	2.250	1.038
(10)	233	137	0.748	1.700	2.890	1.272

Rejecting trials Nos. 5, 9 and 10, then
Total time = 833 seconds.

$$m = \frac{833}{7} = 119.$$

$$\Sigma n = 13.676; \ \Sigma v = 6.049 \ \Sigma n^2 = 187.08.$$

$$\Sigma (n^2) = 26.808 \ \Sigma n v = 11.82.$$

$$\alpha = \frac{187.08 \times 6.049 - 13.676 \times 11.82}{119 \times 187.08 - 187.08} = 0.489.$$

$$\beta = \frac{119 \times 11.82 - 6.049 \times 13.676}{119 \times 26.808 - 26.898} = 0.4188.$$

The following is an example of the use of the meter to determine the discharge of a small stream, the Kleine Luppe, the meter being lowered at uniform speed from the surface at the bottom of the stream.

OBSERVATIONS AT VERTICAL NO. 3.

OBSERVATIONS.	REGISTER ON DIAL OF ELECTRIC CLOCK.		Revolutions of meter.	Time in seconds.	Revolutions per second.	
	At beginning.	At end.				
1.........	815	871	56	66	0.849	Mean 0.9273
2.........	871	941	70	67	0.957	
3.........	941	1,003	62	66	0.939	
4.........	1,003	1,068	65	66	0.985	
5.........	1,068	1,135	67	69	0.971	
6.........	1,135	1,201	76	74	1.027	
7.........	1,201	1,259	58	71	0.819	
8.........	1,259	1,325	66	78	0.846	
9.........	1,325	1,392	67	70	0.957	

Hence *v* = 0.4328 meter per second.

OBSERVATIONS AT VERTICAL NO. 4.

OBSERVATIONS.	REGISTERED ON DIAL OF ELECTRIC CLOCK.		Revolutions of meter.	Time in seconds.	Revolutions per second.	
	At beginning.	At end.				
1.........	1,392	1,526	134	92	1.456	Mean 1.5462
2.........	1,526	1,680	154	102	1.509	
3.........	1,680	1,819	130	91	1.529	
4.........	1,819	1,961	152	93	1.634	
5.........	1,961	2,131	150	92	1.630	
6.........	2,131	2,271	140	91	1.537	
7.........	2,271	2,409	138	89	1.550	

Hence *v* = 0.6427 meter per second. The mean velocity in the section of the river between verticals 3 and 4 is therefore ½ (0.4328 + 0.6427) = 0.5275.

These observations were taken in 26½ minutes, including the time required to shift the float and meter from one vertical to the other.

In the Danube Professor Harlacher has used the meter in a depth of 8 meters (26¼ ft.), and the water there had the great velocity of 3 meters (9 ft. 10 in.). The hollow rod used in this case had a diameter of 50 millimeters (1.92 in.). Professor Harlacher thinks that if the velocity does not exceed 2 meters (6.56 ft.), a rod of that size would be strong enough for depths of 20 meters (65.6 ft.). The only problem to solve would be to connect the pieces of which such a rod must consist.

Professor Harlacher has investigated the variations of velocity in a stream by placing five meters at equal distances apart on the same rod. The meters recorded every revolution independently by means of an electric chronograph.

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RECENT INVENTIONS.

RAILROAD TIE.

The tie or sleeper is made of iron and consists of a flanged base plate, and semicircular adjustable bearing plates resting therein and having depressed chairs. The bearing plates are adjustably secured in the base plates. A clamp extends around the bottom of the chair and over the base of the rails. Angular fish plates recessed to form tongues at their outwardly projecting parts are adapted to be sprung into the bearing plate, and thereby secure the rails.

WATER-METERS.

I see that the Union Water-Meter Co., who advertise in your columns, have issued a very recent patent on water-meters, which is designed to perfect their already highly satisfactory meter. It was found that, in the use of rotary piston meters, the only tendency to leak was at the ends of the pistons. The principal purpose of this improvement is to prevent such tendency, and it consists in forming the ends of the blades and segmental bearings which constitute the co-acting pistons, with grooves or depressions. This arrangement provides an efficient water packing between the ends of the pistons and the adjacent walls of the meter shell. The invention comprises other details of improvement, comprising a novel deflector for the water as it enters the casing, etc.

FIRE ESCAPE.

This improved fire escape ladder consists of a metallic rod or wire having loops formed alternately on opposite sides thereof. The upper sides of said loops are straight and their under sides curved. The loops may be braced by flanged rings placed therein. The descent is made by placing the hands and feet through these loops, the ladder or rod being suspended from the cornice.

FORMING AND TREATING ELECTRICAL CARBONS.

This improved apparatus for treating electrical carbons consists of a burner of argand or tubular form adapted to emit a hollow or tubular flame, with a space or receptacle within the tubular burner freely open at the top to admit and inclose the carbon loop and permit observation of the same while under treatment. Electric circuit connections and clamping devices external to said burner are used to hold the looped carbon within said receptacle and to include the same in an electric circuit. These clamping devices referred to are adjustable forceps mutually insulated and adapted to respectively seize each end of the looped carbon and hold it in the hollow or gases of the flame.

COMPENSATING VALVE FOR WEAR IN USAGE.

This novel valve has a primary valve-disk, exposed around its sides, and provided with the ordinary screw-rod valve-stem. This valve disk has a definite depth and range of wear. The valve-seat has a corresponding deep depressed cavity or socket to receive and envelop the said disk. A secondary seat is formed around the upper edge of said socket to meet with a secondary valve-rim on the holder of said disk when the latter reaches the limit of its wear in the primary seat. The valve-disk is flexible and non-metallic, and of cylindrical form, having a rounded base. The seat or socket corresponds thereto.

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[1] According to Harlacher this formula is sufficiently accurate with his meter for velocities not less than 0.3 meter per second.

* "Die Messungen in der Elbe und Donau und die Hydrometrischen Apparate und Methoden des Verfassers," Von A. R. Harlacher. 4to. Plates. Leipzig, 1881.

CAR LABEL-HOLDER.

This improved label-holder consists of a plate, provided with arms for holding a clamp. This clamp coils around each of the arms, forming springs, and extends vertically therefrom and passes through the plate, where it terminates in spurs adapted to receive the label on the front face of said plate, where it is held by the clamp arms.

RAILWAY SIGNALING APPARATUS.

In this improvement vertical swinging spring-held levers carry pulleys on their pivots, around which pulleys pass reversely around cords which operate the signal flags. When set to "danger," alarm levers are brought into position, to be actuated by a following train in case it enters the "block" before a preceding train has left it. Each train upon leaving a block resets the signals to "safety." F. B. BROCK.

WASHINGTON, D. C.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 135.

CCXCI.—ST. CATHARINE'S.

St. Catharine's, Ontario, Canada, in lat. 43° 5 N., long. 79° 15 W., is on the right bank of Twelve Mile Creek, four miles from Lake Ontario, and at a general level of 120 ft. above its surface, on a plain gently sloping to the north about 200 ft. below the upper plateau of the Niagara escarpment, which runs parallel to the lake shore, and six to seven miles distant from it. Artesian wells of tonic mineral waters give celebrity to the town. In 1846, the population being about 2,000, the Board of Police built small water-works, mainly for fire protection, taking water from the Welland Canal, above the town, and conducting it by wooden logs to a reservoir on Church street. The distribution was by logs of 3-in. and 4-in. bore. The pipes were too small, and were not well cared for, and the works were soon abandoned. In 1876, water-works were built by the town, after the plans of Thomas Monro, C. E., taking the supply from Beaverdam Creek, four miles from the city, and 165 ft. above it. The water-shed is about 12 sq. miles of heavy clay soil overlying limestone rock on steep sloping hillsides. Just above De Cews Falls an earth dam about 650 ft. long and 30 ft. in extreme height, with a puddled core, forms a reservoir covering 60 acres. A leak appeared in this dam in 1879. It was found to be in the old creek channel, through seams in the limestone rock. Bags of Portland cement were lowered from rafts and then filled over with good puddling material. This stopped the leak. The report of 1879 states that the whole bank for 300 ft. is composed of treacherous material.

Another dam of earthwork is built across the stream 1,800 ft. farther up, forming a reservoir of 10 acres area. A waste channel conducts the surplus water from this reservoir, around the lower one and into the stream. Both dams had settled considerably in 1880.

The water is conveyed to the city by a 20-in. cast-iron pipe, which descends the face of the mountain for half a mile, and then reduced to 16 in. continues for 3½ miles. The reservoir is 285 ft. above Lake Ontario, and 165 ft. above the highest point in the city.

Distribution is by cast-iron pipes, of which there were laid on January 1, 1881, 11½ miles of from 12 to 4-in. diameter, with 123 fire hydrants, 129 gates and 546 taps. In order to encourage the use of water the services were at first laid from the main to the street line, by the city, and no charge was made for water. Since April, 1879, water rates have been charged. Iron service pipes are used.

The total cost of construction to January 1, 1879, was $263,070.90. The cost of maintenance in 1879 was $2,868.12, and in 1880 was $1,683.79. The revenue from water rates was $2,890.69 in 1879, and $4,245.65 in 1880. The population is 15,000. The consumption is not stated. The works are managed by a board of six Commissioners. J. Albert Mills is the Superintendent.

CCXCII.—ST. PAUL.

St. Paul, Minnesota, in lat. 44° 57 N., long. 93° 5' W., lies on the northwest bank of the Mississippi River. The bottom lands, submerged in extreme high water, are about three-quarters of a mile wide. The bluff of limestone, underlaid by sandstone, rises abruptly about 100 ft. to a terrace half a mile wide, backed by a range of drift hills rising to 250 ft. above the river. Towards the eastern end of the city, Phalen's Creek enters the river through a ravine.

Settled in 1838, it was incorporated as a town in 1849, and as a city in 1854.

Water-works were built by a private company in 1870, taking the supply from Phalen Lake, the headwaters of the creek, 176 ft. above low water in the river, and 4 miles from the city. This lake is connected by channels, some natural and some excavated, with 19 other lakes. The company has the right of flowage from 1 to 4 ft. on 9 lakes, with an aggregate area of 2,436 acres. In 1878 the inlet stream to Lake Phalen froze solid to the bottom for six weeks.

Water is drawn from the lake by two submerged wooden conduits, extending 800 ft. into 15 ft. water. A 24-in. stoneware pipe and a 16-in. cement pipe convey the water 7,000 ft., when they unite in a 16-in. wrought-iron and cement pipe, leading 15,700 ft. to the city.

The distribution is by 12, 6 and 4-in. pipes, of which 17½ miles are laid, with 188 fire hydrants, 1,817 taps and 129 meters. Four-tenths of the pipes are of wrought iron and cement, and six-tenths of cast iron.

The population in 1880 was 41,498. The daily consumption is about 1,000,000 gallons.

No financial statistics are furnished. John Caulfield is the Superintendent.

The transfer of the works to the city, or the construction of new works by the city have been under consideration of late.

CCXCIII.—BRADFORD, PA.

Bradford, Pennsylvania, in lat. 41° 55' N., long. 78° 45 W., is in the oil region, at the junction of two streams forming Tunungwant Creek, in the valley and on the slopes which rise to 500 ft. above the creek. It is 1,444 ft. above sea level. Settled in 1840, it was incorporated as a city in 1879. Water-works were built in 1877 by a private company, taking the supply from the west branch of Tunungwant Creek, the water-shed of which is 28 square miles, and pumping directly into the mains by 2 Cameron steam pumps of 9-in. bore. A wooden tank, holding 50,000 gallons, is used to equalize the pressure. The ordinary pressure maintained is 110 lbs. and the fire pressure 225 lbs. at the pumps. Distribution is by wrought pipe, in 16-ft. lengths. There are 4½ miles in use, of from 4 to 2-in. diameter, nearly 3 miles being of 3-in. There are 18 fire hydrants, 70 gates and 850 taps. The city does not pay for use of hydrants. Wrought-iron service pipes are used.

The population in 1880 was 8,759. The consumption is not given.

The capital stock of the company is $6,900. The works have cost $25,000 and the receipts have been $35,000. There is no debt. The expenses in 1880 were $5,000 and the receipts $7,500.

S. W. Vandersaal is the Secretary.

CCXCIV.—MOUNT HOLLY.

Mount Holly, New Jersey, in lat. 40° N., long. 74° 33 W., is on Rancocas Creek, on generally level ground, with hills in the vicinity. It was settled in 1680. Water-works were built in 1846 by a private company, taking the supply from Rancocas Creek, and pumping it 105 ft. by a Worthington duplex pump of 600,000 gallons per day capacity, into a reservoir in excavation and embankment, 100 by 50 ft. and 15 ft. deep, with a partition wall dividing it into two parts.

Distribution is by 8 miles of cast-iron pipe of from 6 to 8-in. diameter, with 39 fire hydrants. The number of taps is not given. The town pays $5 per year for each hydrant.

The population in 1880 was 4621. The consumption is not stated.

The capital stock of the company is $15,000. The works have cost $30,000. There is no debt, and a surplus on hand of $1,600.

The expenses in 1880 were $2,500, and the receipts $4,821.65.

Henry C. Risdon is the Secretary.

CCXCV.—STROUDSBURG.

Stroudsburg, Pennsylvania, in lat. 41° N., long. 75° 8 W., is on Brodhead Creek, which affords a good water-power. It was settled in 1779.

Water-works were built by a private company in 1876, after the plans of J. Albert Cloud, M. D., taking the supply from springs 1 mile from the town, to which the water is conveyed by gravity through a 6-in. cast-iron pipe. Distribution is by 3 miles of 6, 4 and 3-in. cast-iron pipe, with 15 fire hydrants. The number of taps is not given. The town pays $346 per year for use of fire hydrants. The population in 1880 was 1,860. The daily consumption is not known.

The capital stock of the company is $15,000. The works have cost $16,000 to the present time. There is no debt. No further financial statements are given.

P. S. Williams is the Secretary and Frederick Phillips the Superintendent.

CCXCVI.—FORT DODGE.

Fort Dodge, Iowa, in lat. 42° 30' N., long. 94° 18 W., is on the Des Moines River.

Water-works was built in 1881 by the city, after plans and under the superintendence of Thomas N. Bontelle, C. E. The supply is taken from the gravel in the river bottom, through a circular, plate-iron tank, 20 ft. in diameter, sunk in the river bed, closed at top and open at bottom. This has yielded 500,000 gallons per day. From this tank, or filter, the water flows into a pump-well, whence it is pumped directly into the mains by two horizontal Cope & Maxwell pumping-engines, with 16-in. steam and 10-in. water cylinders of 24-in. stroke. There is an independent 14-in. pipe from the well to the river, closed, except when the draught exceeds the capacity of the filter, when the river connection is automatically opened.

Distribution is by 1½ miles of cast-iron pipe of from 10 to 4 in. diameter, with 19 fire hydrants. The number of taps is not given.

The population in 1880 was 3,700. The consumption is not stated. The works cost $20,400. No further financial statements are given.

S. T. Meserney is the Chairman of the Water Committee.

CCXCVII.—TARRYTOWN.

Tarrytown, New York, is on the Hudson River, 25 miles from New York City, on ground sloping steeply from the river to a height of about 300 ft.

Water-works for fire protection were built in 1877 by the village, after the plans and under the superintendence of Charles E. Fowler, C. E.

A Woodward steam pump, with 12-in. steam and 5-in. water cylinder, pumps water from Andre Brook, 300 ft. into a reservoir 50 by 40½ ft. and 18 ft. deep, excavated in rock, lined with brick and covered with four brick arches of 9-ft. span and 2-ft. rise, springing from three pairs of rubble-stone piers. The arch is covered with 1 ft. of earth. The water of the brook is filtered through sand and gravel before entering the pump well.

Distribution is by 2½ miles of 8, 6 and 4-in. cast-iron pipe, with 15 double-nozzle fire hydrants.

The works cost $16,500. In 1881 an artesian well of 8-in. bore was sunk 600 ft. to procure water for domestic use. It yields 5,500 gallons per day when pumping from a depth of 200 ft.

No further information has been given. The population in 1880 was 4,514.

CCXCVIII.—ROCKLAND.

Rockland, Maine, in lat. 44° 7' N., long. 69° 6' W., is on Owl's Head Bay on the Atlantic Ocean.

It was incorporated as a city in 1854. Water-works were built in 1851 by a private company. The supply is taken from a lake and pumped directly into the mains by a Holly pump erected in 1869 and driven by water power. An ordinary pressure of 30 lbs. is maintained. In 1878 distribution was by 33 miles of wrought-iron and cement pipe, with 10 fire hydrants. The city exempts the company from taxation in consideration of fire protection.

The number of taps and items of expenses and receipts are not given.

The capital stock of the company is $106,850. The population in 1880 was 7,650.

N. T. Sleeper is the Secretary and John Howard the Superintendent.

[TO BE CONTINUED.]

The receipt of statistics, as follows, is acknowledged with thanks: From J. Opperman, C. E., statistics and water rates of the water-works of Bradford, Pa. There are no water-works in Bristol, R. I.

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BIDS RECEIVED FOR WATER-WORKS CONSTRUCTION.

From Chester B. Davis, C. E., Chief Engineer of the Madison, Wis., Water-Works, we have received a copy of the report by the committee to the Common Council on the bids received for work and materials for the proposed system of water-works. The amount of material bid for, in whole or in part, aggregates about 950 tons in weight. The pipes are of the following description:

17,000 ft. 4-in. pipe	20 lbs. ts a foot
32,000 ft. 6-in. pipe	31 lbs. to a foot
6,000 ft. 8-in. pipe	42 lbs. to a foot
1,750 ft. 10-in. pipe	60 lbs. to a foot
1,025 ft. 14-in. pipe	100 lbs. to a foot
480 ft. 16-in. pipe	130 lbs. to a foot

We quote as follows:

"The awards recommended herein are summarized as follows:

Cost of valve-boxes	$300.00
M. Philbin & Co., pipe-laying, etc	13,370.90
Cincinnati & Newport Pipe Co., pipe	37,694.46
R. D. Wood & Co., hydrants	2,900.00
Ludlow Valve Co., valves	1,208.20
Total cost for street work	$55,473.56
Engineer's estimate for same work	56,500.00
Difference	$1,026.44

"The combination bids for doing all the work and furnishing all the materials, or a part of said work and materials, were as follows:

R. D. Wood & Co., pipes, hydrants and valves	$42,570.00
Truman Cowell, pipe, pipe-laying, hydrants and valves	56,150.00
McRitchie & Nichols, pipe, pipe-laying, hydrants and valves	56,876.41

"John F. Gray has submitted a proposal to dig the wells, one or more, 6-in. bore, and furnish all tubing and material, for $2.25 per foot, for a distance of not less than 650 ft., and not to exceed 1,500 ft. This proposal the committee recommend should be accepted, as the lowest and best bid."

The Water-Works Committee and the Engineer were instructed by the Council to close contracts with the successful bidders.

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.

Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR. .... ASSOCIATE EDITOR.

SATURDAY, MAY 6, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—ANNUAL CONVENTION, WASHINGTON, D. C., MAY 16, 1882.—The Annual Convention of the Society for the year 1882 will be held at Washington, beginning Tuesday, May 16, 1882. Sessions for professional discussion and one for the transaction of business will be held. At one of the sessions, the annual address will be delivered by the President, Mr. Ashbel Welch.

The general arrangements for the Convention are now in preparation, and will be announced. Details of the programme are in charge of the local committee at Washington, the chairman of which is Col. Thos. Lincoln Casey, Corps of Engineers, U. S. A., Director Am. Soc. C. E.

The families of members are invited to accompany them.

AMERICAN INSTITUTE OF MINING ENGINEERS.—PRELIMINARY ANNOUNCEMENT OF THE COLORADO MEETING.—The next meeting of the Institute will be held in Colorado, beginning in Denver on Monday, Aug. 21, 1882. A week or ten days will probably be spent in the State. A subsequent notice will give the detailed programme of the meeting and the arrangements which may be made with railroad companies for excursion rates to Denver It is necessary that the Secretary should have in good time the names of the members and associates who expect to attend the meeting, with the number of ladies who will accompany them.

It is desirable that there should be a large number of papers presented at this meeting, and members are requested to send the titles of their papers to the Secretary as soon as they can.

R. P. ROTHWELL, President,
27 Park Place, New York City.
RICHARD PEARCE,
Chairman of Local Committee, Denver, Col.
T. M. DROWN. Secretary.
EASTON, Pa., April 28, 1882.

MALARIA—WHAT IS IT AND WHENCE ITS SOURCE?

This term, we believe, was first used in connection with the emanations from the low lands of that district of Italy extending from Leghorn to Terracino, and from the sea to the Apennines. The term has now become of general application to deleterious emanations from decaying organic matter of any description, while the term miasma is now more restricted to the emanations from marshy lands and stagnant waters which are fruitful in producing various forms of intermittent and remittent fevers. Malaria has been called the modern Proteus, varying in character as influenced by local conditions, temperature, place and time; adopting any form that accommodates it to prevalent influences; mingling its characteristics with those of almost every human malady and modifying their essential features. Position and environment do not bar its progress. It occupies alike reeking bog and marsh, valley or hillside, flourishing alike upon arid plains and deserts, nor disdaining the dry precincts of a granite quarry perched high among the hills. Climate affords but little check to its progressive march, and the character and form of its attacks are as various as the localities. Can we wonder then tha so little being known of it beyond its effects, its presence may be, and is, assmed as the cause of a host of diseases having but little to appearances in common with each other, but all susceptible, at least, of modification through its influence. Disbelief in its existence, even as a source of disease, has become extended by reason of the readiness of the modern practitioner to attribute to the influence of malaria any disease brought to his notice the pathology of which is at all obscure.

A paper on the comparatively recent appearance of malaria in Connecticut, a section of country heretofore enjoying the reputation of high healthfulness, appears in the Fourth Annual Report of the Connecticut Board of Health for 1881, from the pen of C. W. Chamberlain, M.D., the Secretary to the Board; and the answer to queries addressed by him to the medical profession practising throughout the State gives the local information bearing upon this subject. From this source we quote very briefly from a few towns, not by any means aiming to epitomize the report, which is exhaustive and highly interesting, but simply to give so much as shall indicate to our readers the subtle character of this foe to health, and the necessity that every individual shall to a greater or a less extent inform himself of what is known of the sources of malaria, that his own local observations may be of use in increasing the general store of knowledge upon the subject, for unlike many branches of science, this is not one "where a little learning is a dangerous thing;" but great results may flow from apparently very inadequate means and limited observations.

The reports from the various towns of the State of Connecticut are very interesting, and in many cases curious, and, according to Dr. Chamberlain, "generally disprove the necessity of marshes or vegetable decomposition for the production of malarial poison, however they may favor its continuance."

Of 40 towns in the State, out of 140 from which reports have been received, malarial fever appeared first upon the high land; in four of them, upon the highest land in the place.

New Haven.—About 1875 a freshet carried away the tide-gates at the mouth of Nest River. For the first time in this century the salt water inundated one or two square miles of fresh meadows, killing the trees and all vegetation. The gates were not replaced for two or three years. Vegetation was almost wholly destroyed. When the gates were replaced, and the water receded, large amounts of vegetable deposits were left, including dead trunks of trees. Here we have, on a large scale, one of the most favorable conditions for the development of malaria, according to the writers, nor was the germ or particulate of malarial fever wanting in the region threatened, yet there was no epidemic of malarial fever resulting therefrom.

Naugatuck.—I have lived the most of my life in this town and never heard of any one having chills and fever, until 1865, when I came home from the war, and then I knew of none except in cases of returned soldiers. In 1872 or 1873 I began to hear, more or less, of dumb ague and malaria, and since then both have been apparently on the increase in this locality.

Stratford.—As near as I can learn, intermittent fever first appeared here on *high ground*, about a quarter of a mile from a marsh. Malarial diseases are constantly increasing in frequency. Those living near the low-lying, salt meadows seem to be more exempt than those living far away.

New Canaan.—Intermittent fever first originated here about 1870. The first cases were of persons living upon low ground near streams. Its appearance was gradual from the towns bordering on the Sound, and was three years in reaching the village, following the stream at the rate of two miles yearly. On it went, northward and inland more slowly, but by steady steps for years, until out of my jurisdiction. I know of no local conditions about ponds, dams or streams, that differ materially from their condition fifty years ago. In general, the well-fed, well-to-do classes are less affected, while the hard laborers suffer most.

Trumbull.—Tertian in 1874, on the highest ground in the town. No local causes to induce malaria—no changes of land or water from the condition that had existed many years. Malarial diseases since 1874 have generally prevailed, affecting all ages.

Stepney.—There is absolutely no cause to account for the extensive prevalence of malaria in this region, which has affected nearly every inhabitant. All the old theories about its causation have been badly damaged by the manifestations in the recent outbreak. There has not been a dam constructed for fifty years. Typhoid fever, very prevalent ten or twelve years ago, is steadily diminishing—no case in three years part.

Bloomfield.—Intermittent appeared first 1875. Town occupies a level sandy plain, but few hills and but little meadow or swampy ground. The locality had no influence in inducing its appearance, as there have been no changes favorable to its production during the thirty years which I have practiced here. Whatever may be the theories in regard to marsh miasm and other recognized causes, we must admit that here it travels very independently and with very great disrespect for the rules which have been laid down for it. Malarial diseases have increased in frequency this summer, and with their increase, the decrease of typhoid fever has been regular and rapid—hardly a case for the past two years.

North Manchester.—The first cases of intermittent fever appeared here in 1878 on high ground, a half-mile from any pond or meadow. There have been no changes whatever to induce malaria that have not existed for years. The greater number of cases appeared near a low swampy tract, but this latter has existed in its present condition for a *great many years.* About 70 per cent. of all the cases I see appear to be of malarial origin, affecting all ages. Regular intermittent the prevailing type. Can find no record or history of the existence of malaria in the early settlement of the town. After investigating and watching its features closely, I conclude that vegetable decomposition alone is not sufficient to produce it, nor does the elevation of the land, nor the best sanitary surroundings protect. Telluric changes have *little* influence upon its production.

Hebron.—First case occurred in 1870, upon moderately high ground, a pond half a mile distant; no marsh or swamp in vicinity; a railroad built eight or ten years ago partly through a swamp; no natural drainage thereby obstructed, but more ague in the vicinity; no other favoring local conditions, actual or possible. About eighty or a hundred years ago people living in the vicinity of a tract of flooded land affected by fever and ague; malarial diseases appear to be increasing; less typhoid fever since the appearance of malaria. The reason for the present spread of malaria is *not* found in local conditions, but the producing cause or source has been introduced by some *general agency*, and has found, so to speak, a soil fitted to reproduce it where formerly it *did not exist*.

South Glastonbury.—No cause for the unusual frequency of malarial disease, except the unusual low stage of the river be considered such. I think the germs of malaria reach Connecticut from the flats of New Jersey, and, passing along the coast as they meet the streams, follow their course. This used to be a hot-bed of typhoid fever, but for the past ten years there have been but few cases.

Wethersfield.—Since the prevalence of malaria typhoid fever has been rare, and consumption far less frequent. No local cause to produce malaria. There have been no changes for years, with the exception of the construction of the Valley Railroad; *but malaria was already there*, and its prevalence no greater near the railroad than elsewhere.

Newington (formerly part of Wethersfield).—Same general condition prevalent here. As it lies back from the river, there are no lands to be overflowed, except near small streams. Hills more abundant, and the dwellers thereon equally affected with those on the low lands, but not as severely, nor the cases so persistent.

Rocky Hill.—First case in 1872 of typical intermittent, occurring on high ground entirely away from the vicinity of marshes, ponds or streams. During the summer there were four cases near a mill pond, which was in the same condition that it had been for seventy-five years. Do not believe that the local surroundings have had anything whatever to do with malarial diseases in this town. Do not know of any disturbances or conditions out of which malaria could be evolved. Have no possible causes capable of generating that hypothetical factor denominated marsh miasm that has not been present with us for the past hundred years. Have two mill ponds in lower part of the town on the same stream. They have been in the same condition as at present for over a hundred years. A third pond between the two built twenty-five years ago. In the summer of 1876 the three ponds, all within a distance of half a mile, were drawn off, and the vegetable decomposition collected in them left reeking in the sun in the condition supposed to favor the evolution of paludal poison. Yet there were no cases of fever of any kind in the neighborhood, but there was intermittent in other parts of the town remote from them. Typhoid fever has been absent since malarial diseases came in. Whether the facts are simply coincident may be a matter of doubt. My opinion would be that there is some unknown relationship between the increase of intermittent and the outgo of typhoid, but not fortified by such evidence as to render it an established fact. The acceptance of the idea of the substitution of one form for the other would militate against the doctrine of specific germs as the etiological factors for each special fever. The theory that there are living microscopic existences that get from the soil into the human system and produce there the phenomena of intermittent and the cognate diseases as developed by the Italian physician, Crondelli, is plausible, but it lacks confirmation.

Chetham.—Malarial diseases have been slowly creeping this way from the vicinity of Middletown and Portland. I do not think the railroad through the town had any connection with the causation of malaria, as it commenced in Portland while the railroad was under discussion, before its construction *was commenced.* Do not see much relative difference in the number attacked, nor the severity on low, swampy ground, or on high, dry ground. It has prevailed in the most hilly districts as much as in the lowest or flattest, and live or six miles from the railroad as much as in the immediate vicinity.

Old Lyme.—First case in 1877, on low ground surrounded by marshes. Families who have paid particular attention to drainage and all sanitary measures are as violently attacked as those whose dwellings are surrounded by filth and swamps. Those who live on high hills with no swamps near are not exempt—malarial diseases have prevailed the length and breadth of the town; but few have escaped.

Middletown.—Ever since this place was settled it has been exposed to all the elements one would suppose favorable to the production of malaria. Running the whole length of the territory is the Connecticut River; on the south and southwest are ponds and streams, and the same on the north and northwest. Joining the two is an extensive marsh and swamp, leaving only a space of high land perhaps fifty rods wide to connect us with the main land of Connecticut: yet, with all these surroundings, and with only imperfect drainage, malaria was unknown for 238 years, or from the first settlement in 1635 to 1873. Since 1870, pure water has been introduced, and the city has been thoroughly sewered and now malarial diseases are abundant.

The above-named towns are selected from a large number of returns as exhibiting local peculiarities in reference to the existence and spread of malaria in the late outbreak in Connecticut. It is to be presumed that the reporting physicians were equally reliable in all cases, and we have the evidence of the danger to be apprehended from a hasty generalization based upon a few isolated facts. In other words, we *know* absolutely nothing as to the source of malarial disease. The chemical analysis of the air of malarious swamps shows nothing having any relation to the production of periodic fevers, or at least no proven relation; and the theories to account for the source of the poison have been of the most varied character—many of which are noted by Dr. Chamberlain, but which space will not permit us to quote, further than to refer to that of Krebs and Crondelli, who attribute the poison to a form of bacteria known as *bacillus malaria*, which is figured in a plate accompanying this report as a rod-like microscopic body containing a spore at each end and sometimes one in the *middle*, and grows in long, curved filaments divided by joints, and so far as we can judge, analogous to, if not identical with, Professor Koch's bacillus found by him to be the parasite which gives rise to tubercular consumption, a discovery which may be characterized as the

DISCOVERY OF THE AGE !

the possibilities of which in the early future toward diminishing the ravages of diseases may prove of incalculable value to the human family. The details of this late discovery by Professor Koch, of Berlin, form the subject of a letter from Professor Tyndall to the London *Times*, a synopsis of which by the Brooklyn *Eagle* is too well conceived to be lost, and we offer no apology to our readers for laying the greater part of it before them without mutilation.

The germ theory has long been suspected as underlying many of the most serious diseases. Practical inquiry and experiment have demonstrated, beyond a doubt, that eruptive fevers like small-pox, splenic fever in cattle, and Asiatic cholera, are due to the rapid multiplication in the system of certain organic germs. Pasteur, by a series of brilliant experiments, at last succeeded in turning this revelation to account. He found that precisely as the little microscopic spore or bacillus, by being permitted to develop in the body of the ox lost its virulent properties and produced a disease in man identical with small-pox but much milder, and prevented, under certain conditions, an attack of that disorder, so the germs which cause other eruptive diseases may be modified and administered by the same process as vaccination, with certain specific results, in protecting the inoculated body. And now the crowning discovery of the age is announced by Professor Koch, of Berlin. The one incurable disease of humanity, whose victims have been numbered by millions, and which carries off one-seventh part of the whole human family, is discovered to be due to a germ like that of small-pox, typhus and cholera. The active agent of consumption has been detected. It is a little rod-shaped, microscopic bacillus, embedded in the tubercle, which does all the mischief. Dr. Koch had long pondered the subject of consumption and sought to trace it to some other source than the tubercle. He found it with the microscope; he has trained and bred it for ten generations, and found that at that distance from the parent germ it is just as virulent as it had ever been. Once inoculated with this germ, no matter how minute, the body nourishes it into active life and reproduction, the organs of the body become infested with the generations of organic life, which in their growth excite the tissues to the formation of tubercles, with the deadly consequences so familiar to us all. It is no longer believed that cold and exposure are the true causes of tuberculosis. They may produce changes in the system which will favor the development of the germs more or less rapidly, but the bacillus must be in the system originally before it can be made active in bringing about tuberculosis. It is generally understood, by the way, that half the human race is more or less tuberculous. Consumption thus shows itself to-day as a contagious disease. Knowing this much of its origin the scientific world is now busy in attempting to meet and destroy it.

Dr. Koch was led to his investigations of tuberculosis by the experiments made by him in the line of Pasteur's researches. How he proceeded, after detecting the bacillus—an organism of parasite so small as to be visible only under extraordinary magnifying power—and cultivating it, will doubtless be interesting. Professor Tyndall, writing to the London *Times*, describes it. Taking a speck of matter from a tuberculous human lung he infected a substance prepared by himself as nutriment for the parasite and let it develop. A minute drop of this mixture was then permitted to infect another nutritive substance, and in due time, after development, a drop of this was again used, and so on until many generations had gone by. At the end of this time minute quantities of the last mixture were injected into various animals, and in every case, without exception, they died of tuberculosis. Six guinea pigs were experimented with. Four were inoculated with a scarcely perceptible amount of a preparation of the fifth generation of the parasite and two were untouched. The four thus infected sickened and lost flesh. At the end of 32 days one died, and four days later the other three were killed. Every one of them had well-marked tuberculosis in the spleen, lungs and liver, while the two which had not been infected, when killed, were absolutely free from the parasite as well as from tubercles. Eight other guinea pigs were infected with cultivated bacilli of the eighth generation, the original being a speck of lung of a consumptive monkey. The results were identical, the disorder losing none of its virulence. Similar experiments were made with cats, rats, mice, rabbits and other animals, and injection of the fluid into the system was invariably followed by decided and in most cases virulent tubercular disease. Rabbits were injected even in the aqueous humor of the eye with the cultivated bacillus and were victims of tuberculosis, and so on through a series of patient experiments.

Another series of experiments was made to ascertain the nature of the tubercular bacillus. Unlike the splenic fever spore, it is not what might be called a hardy plant. The limits of temperature between which it can develop and multiply are 86 and 104 degrees. In the temperate zone, therefore, it cannot flourish, except in animal bodies. It can be dried, however, without being robbed of its vitality, and hence may be circulated in rooms as dust breathed into the lungs and vivified. The expectorations of persons troubled with phthisis are found to be swarming with these parasites, while those of persons not so afflicted are entirely free. An inference is, therefore, to be made that consumption, instead of being hereditary, is communicated by the germ-laden air of the patient's sick room, especially to those members of the family more especially in attendance.

So many considerations arise, provoked by this superb revelation, that one cannot give space to them. It would be interesting to know what the effect of diluted alcohol is upon the tubercular bacillus. Enlightened practitioners have already begun to administer alcohol copiously to consumptive patients, the theory being that it prevents waste of tissue, and so aids in building up new tissues. That it has this effect experience familiar to many has demonstrated. But if it is found that its specific action is to kill the parasite itself pure liquors put on another aspect from that persistently regarded by the Prohibitionists. It may yet be proved that the universal appetite of animals, from men down to rattlesnakes, for strong drink, is a dumb perception of Nature's antidote for disease germs, and if this is the case the very habit which is assailed as a curse may after all have proved to be man's salvation.

It is not too early to believe, therefore, that consumption will, within a few years, be as readily met and mastered as any ordinary malady, and it may yet happen by a modification of the tubercular bacillus or parasite, persons can be inoculated against consumption as well as against small-pox.

PERSONAL.

J. A. Macdonald is Chief Engineer of the Orange Ridge Railroad. Offices at Sanford, Fla.

Capt. T. Y. Dabney, of Shreveport, La., has been appointed chief assistant engineer in charge of construction on the Vicksburg, Shreveport and Pacific.

Mr. O. F. Nichols, Mem. A. S. C. E., for the last three years with the New Jersey Steel & Iron Co. at Trenton, N. J., has just been appointed Resident Engineer of Henderson Bridge at Louisville, Ky.

Benj. Franklin Delano, formerly a United States naval constructor, well known before the civil war and in the early part of the conflict, died at his residence, No. 115 St. Marks Avenue, Brooklyn, on the 30th ult.

Col. E. W. Cole has resigned his position as President of the East Tennessee, Virginia and Georgia Railroad Company. The Directors have elected Gen. Samuel Thomas as his successor, and Major Henry Fink as Vice-President. Col. Cole continues to be a Director of the company.

Philip Golay, C. E., in charge of the long Trestle Bridge across Lake Pontchartrain, on the New Orleans & Northeastern R. R., has resigned, and goes to take charge of the government work at Grand Chain, on the Ohio River, with headquarters at Paducah, Ky.

The Continental Railway Company, at a meeting held April 21 in this city, elected the following Board of Directors: General W. C. Kibbe, of Brooklyn; Milton Westen, of Chicago; Thos. P. Johnston, of New Jersey. George H. Ely, of Ohio; W. M. Barnum, of Connecticut; C. C. Deming, C. W. Ramsey, Willoughby Weston, C. B. Hotchkiss and R. N. Funkhouser, of New York, and D. Messmore, of New Jersey. Messrs. Smith and Johnston were in the old board, and the following directors hold over: Geo. E. Yarrington, of Massachusetts; R. S Dwiggins, of Indiana and S. D. Cousins, William Thorp, A. G. Day and J. B. Stewart, of New York.

M. Henri Giffard, the well-known French engineer, who recently died, has, it is said, left the whole of his fortune, amounting to several million francs, to the French Government, to be employed in the furtherance of scientific research. Giffard is best known to the public from his connection with the great captive balloon at Paris; but his fortune was probably due, as his fame certainly was, to the invention of the injector—a small appliance used for forcing water into steam boilers and for other purposes. He died at the comparatively early age of fifty-seven, and as he was not married there are presumably no relations to mourn the loss of his munificent gift to the French nation.

Gen. Wm. L. Burt died of paralysis at Saratoga, N. Y., April 2. He was born in Wilbraham, Mass., in 1809, and at an early age removed to Ithaca, N. Y. He graduated at Harvard College and the Harvard Law School, and in 1853 began to practice law in Boston. During the war he was Judge Advocate General on Gov. Andrews' staff, and took an active part in raising and sending forward troops from Massachusetts. For nearly eight years he was Postmaster of Boston. Gen. Burt early took an interest in railroads, and was the projector of the Suffolk Horse Railroad and other local projects about Boston. He was the projector and for several years President of the Utica, Ithaca & Elmira road, and later was the projector of the Boston, Hoosac Tunnel & Western, and was President of that company at the time of his death.

M. Ferdinand de Lesseps was feasted on the night of April 19 by his fellow townsmen of Versailles. On the house where he was born on the 19th of November, 1805, a commemorative tablet was placed in the presence of an enthusiastic gathering, and this was followed by a monster banquet. The veteran engineer ridiculed the English fear of the Channel Tunnel, which he facetiously called "the French Pipe," and prophesied it would become as great an accomplished fact as the Suez Canal. A guest having drunk to the completion of the Panama Canal, M. de Lesseps replied; "I invite you all to the opening of the canal. It will take place in 1888, and I feel convinced that I shall be there too." The ladies present were interested to learn that Mme. de Lesseps gave birth to her tenth child a fortnight before.

C. C. Lovejoy has resigned his position as Superintendent of the New York works of the Hudson Tunnel to accept the position of Superintendent of Bridges and Buildings on the N. Y., W. & O. R. R., under Chief Engineer Walter Katté. We congratulate the latter company on the acquisition to their force of so able a man. Mr. Lovejoy will be missed at the tunnel, for he was very popular with the employés of the New York works, as was evidenced by the presentation, previous to his departure, of a handsome silver water service by the foreman and assistant foreman, and a handsome meerschaum pipe by the laborers. Mr. Lovejoy's ingenuity and aptness in emergencies are such that it seems strange he should be allowed to leave the tunnel works, where, we understand, much if not all of the successful issue of the New York work has been due to his ingenuity and untiring superintendence and watchfulness. May success attend him in his new field of labor.

PROGRESS OF ENGINEERING IN 1881.*

Gentlemen of the Western Society of Engineers:

Our Society, which originated about thirteen years ago, may be said to have passed during the year 1881 through the trials and dangers of a new birth, consequent upon the recent changes in its organization and the wider aims then adopted. Instead of being in name simply a local club, expecting a membership from but a limited territory and looking apparently only to civil engineers for accessions, it has adopted a title which will apply to more than one-half of our national domain and to all who are, or have been, employed in carrying out the principles of engineering.

The first half of the year was much taken up with the discussion of measures. The most important result has been the union now existing with the Boston, Cleveland and St. Louis societies in the formation of an association for the publication of the proceedings of the societies thus united. If the character and appearance of the numbers of the *Journal of the Association* thus far published, and the proverb, "In union is strength," can be taken as grounds of prophecy, we may predict an encouraging and creditable future for it. How shall such a journal be sustained? Money can generally be obtained by wisely directed appeals, and interesting matter for publication can be procured by compilations from existing treatises and articles of acknowledged value; but unless we can furnish for the *Journal* papers containing at least some original matter of interest in some branch of engineering, then, as far as we concerned, such a publication will fail in its most important object. The three essentials to our prosperity are increase of membership, a greater amount of income and the frequent production of articles worthy of publication and likely to be valued by engineers interested in the subjects treated. Other things are very desirable, such as permanent, well-lighted, comfortable rooms, a good reference library, and sufficient means to keep the rooms and library always accessible and serviceable to the members. If, however, we do not yet possess these things, or owing to our position with regard to kindred societies, or to our peculiar surroundings, our growth should be slower than we hoped for, we ought not to be discouraged.

Having first settled it firmly in our minds that the best interests of a large number of engineers demand an organization whose meetings should be held in this city, duty requires us to sustain such an organization. We have already a membership sufficiently large to produce many valuable papers. The character of these is what must determine our usefulness outside of our membership. "What should be our highest aim as engineers?" Should it be to stand at the head of the profession, or to scrupulously discharge the duties of the positions in which we are placed? If the former, then we have many chances of failure to one of success, which will so often depend upon circumstances entirely beyond our control. If the latter, then success depends upon ourselves; for it is assured by a simple and constant attention to the requirements of each occasion as it arises. Of course, this implies honesty not only in the discharge of duty, but in a careful preparation for it. When the attainment of the highest position is the all-absorbing or controlling motive it may lead to injustice to others, to seeking their positions, or to claiming credit not deserved. The true engineer will shrink from all of these and, as a rule, make but little if any claim to credit, leaving it to others to say what he deserves. He will occasionally discover quite a diversity of opinion on the subject, especially if the press should take it up; but if he is prudent he will keep out of the controversy.

We should be ever ready to help and advise each other, to strengthen private judgment; but this should not be carried to the point of giving to employers responsible professional advice for which they do not pay. This would not be mentioned if some cities and towns did not endeavor to get valuable advice from engineers without paying for it, when they would not expect to get it in a similar manner from doctors or lawyers.

Engineers are often depressed with a sense of injustice in regard to their pay and relative position among the officers of a city or corporation, or as compared with the members of other professions. Salaries are sometimes cut down so as to make it impossible for an engineer to live in a manner befitting his position or to properly educate his children. A remarkable instance of cutting down has been reported lately. In a city containing many intelligent and enterprising men, the office of city engineer was let out to the lowest bidder at $900 a year. No wonder the "successful competitor" is said to have employed as rodman a boy only eight years old! If a distinguished surgeon or lawyer should charge several hundred dollars for a few hours' work, it is acquiesced in as a reasonable compensation for professional knowledge, experience and ability; but if an engineer should make corresponding charges, he would excite astonishment, at least in this country. But these things cannot be changed by merely speaking against them; and there is an encouraging side. If the increasing number of engineers who have recently been placed in positions of great importance, as presidents and vice-presidents, general managers and general superintendents of railroads and other corporations, may be taken as a guide, it is not unreasonable to hope for a return to the custom that prevailed fifty years ago, and later, of giving the charge of operating completed works to those who had constructed them. At all events, such a state of things is much more likely to be brought about by the exercise of the kindly feelings and scrupulous regard to duty before mentioned among engineers themselves than by the opposite or purely selfish course. Even if promotion and pecuniary prosperity should not result, the advancement of engineering certainly would, and this means advancing the interests of mankind. To be a benefactor to one's race should be, and is by right-minded persons, considered more honorable than the mere possession of wealth or position.

In regard to the progress of engineering during the past year, a statement of which is expected of the retiring president, it is not an easy matter to tell where to begin or where to end. In every branch of engineering there are units of measure or standards of comparison. How shall we apply them in this case? As with the heavenly bodies, actual progress can only be determined after a long series of carefully made and considered observations, so in the latter a knowledge of and careful comparisons with the past are essential to a determination of actual progress as well as its measure. If we consider the amount of engineering works constructed during the past year as evidence of progress, then it was probably greater than in any previous year in the history of the world. But mere repetition or duplication, however extensive, cannot be considered real progress in engineering any more than a multiplication of books in successive editions can be considered progress in literature. We cannot help associating with the idea of progress something new either in principle or combination. What can we find in these respects to apply to the past year? If we might look back but a little more than fifty years it would be easy indeed to prove that there has been great progress. Allusion only will now be made to recent progress in a few directions.

Descriptions of most of the works now in progress or contemplated have appeared in the numerous weekly and monthly journals with which engineers are so well supplied. It would be difficult to point to a more striking evidence of the progress of engineering than the number and character of most of these journals, which could not have been sustained a few years ago.

The enormous loss of the force residing in coal when applied to useful effect through the steam engine continues to exercise the ingenuity of inventors, and the number of abandoned contrivances for saving fuel is constantly increasing. The most promising direction in which to look for a saving of some part of the great loss of force now experienced continues to be in the use of steam of higher initial pressure. This has led to increased strength of boilers; but the use of steel of excellent quality, now produced at such low comparative rates, makes it as easy and as safe to navigate the ocean with steamers having boilers bearing 100 lbs. pressure as it was with those having but 10 lbs. pressure forty years ago. Even less than the pressure of the atmosphere was advocated by naval men, so that in time of war a ball through a boiler, instead of letting steam out, would let air in. The newspapers last year published accounts of a steamer which crossed the ocean to this country, the "Anthracite," that had a boiler pressure of 300 pounds. How long it will take to introduce such a pressure generally, it is useless to speculate upon. The re-introduction of compound cylinders, so long laid aside, while not increasing the duty of the steam engine theoretically, does increase it, by making it practicable to use the expansion force of steam to a much greater extent than formerly. Actual experience has caused all the leading lines of Atlantic steamers to be provided with engines of this type. For stationary engines, such as pumping-engines, the tendency is in the same direction; but for most other purposes such a tendency cannot be claimed, the question depending upon such considerations as first cost, rate of expansion desired, and size and purpose of engine.

Substitutes for the steam engine do not appear to have made much advance. Yet at the close of a lecture recently by the Electrician to the General Post-office, London, Sir William Thomson said at Glasgow: "The steam engine was passing away and the gas engine would supply its place." Thus far progress in that direction on a large scale has been very slight. Ericsson's small caloric engines are said to be manufactured quite extensively; their extreme simplicity, being without valves, makes them very desirable for many purposes. If Sir William's views are realized, "we must look forward to the time when, instead of getting up steam, fire will be applied direct to do the work." Also that "three years ago scientific men, who should have seen such a thing beforehand, but did not, scarcely credited what has now been shown by engineers, that gas used to drive a gas engine and produce the electric light, gives much more light than when used directly."

Of the increase in the number of miles of railroad in this and other countries during the year it is impossible to speak with certainty, except to say that it exceeds that of any former year; and is therefore the most striking measure we have of the increased application of engineering works to the wants of mankind. The effects of this increase, though at once great, cannot be limited to the present. The numerous important links that are to form connections between the Atlantic and the Pacific, beginning with the Northern Pacific and going southward, not merely to the Southern Pacific, but passing over into Mexico, have made great progress.

In the crossing of mountains, steep grades continue to be adopted. By increasing the weight and number of locomotives, and resorting to tunnels when necessary and loops when practicable, it would seem as if there were no mountains in the world which might not be traversed by the locomotive. We hear of the 90-ton locomotive, including tender, on the Pacific slope. When this is compared with the 5-ton engine, considered heavy fifty years ago, we see great progress.

If no marked change has taken place in the forms of railroad equipments recently, they have been benefited by the improvements made in the manufacture of materials, especially in the use of steel, which for rails continues to show the great superiority and economy, as compared with iron, claimed for it years ago.

The enormous increase of business on the leading lines of road calls for terminal facilities in large cities not dreamed of when the railway system was commenced in this country.

No branch of engineering requires more skill and care than that demanded in some cases for the renewal or repairs of bridges on railroads over which the regular trains must not be interrupted if it can possibly be avoided. Probably the most remarkable example of this kind in our country is the late thorough repair and renewal of parts of the Niagara suspension bridge. In a recent case, where the fall of part of a bridge interrupted traffic, it is said the losses were a million dollars or more, whereas could the renewal have been made without interrupting traffic the cost would not have been $100,000.

The prevention of accidents on railroads has always called forth much ingenuity and care; yet some of the most fearful that have ever happened have occurred recently. The block system is extending and is the most certain means known for preventing collisions of trains, but its heavy expense has prevented its general adoption thus far in this country. Experiments are now in progress for determining the practicability of substituting automatic electrical apparatus to a still greater extent for a part of what is now done by men. The frequent examination of bridges has no doubt led to the prevention of many calamities, and yet several recent instances of serious accidents occuring at bridges shortly after their examination, make it painfully apparent how easy it is to overlook vital points. Accidents and failures lead to renewed study of their causes and thus advance engineering knowledge, though sometimes at a fearful cost of life and money as well as great grief and mortification to those who are held responsible for them. It is very easy to point out the defects of a structure after it has failed; but only those who point out such defects before the failure, and especially during the planning or construction of the works, deserve much praise; for after everybody becomes familiar with a fact, there is little credit in promulgating it.

One important element of danger on railroads, especially to bridges, is the gradual yet in the aggregate great increase in weight of engines and cars, and speed at which they run. Structures which originally had a large factor of safety have had it gradually diminished to nothing, not only from the causes mentioned but from deterioration or defects of materials not originally suspected, while theoretically they were still safe.

The actual progress in bridge building during the past year is said to consist, not in the discovery or carrying out of any new principles, but in the more perfect adaptation of those principles to all the parts or such structures. Decided improvement has been made in the strength of materials and modes of testing it, and the forms and proportions of parts, now considered almost perfect.

The Brooklyn suspension bridge, though not yet finished, and up to this time the most remarkable bridge in the world, having a center span of about 1,600 ft., seems likely to be eclipsed by the wonderful bridge planned for crossing the Forth, which has two spans of 1,780 ft. each. The novel and exceedingly bold application of principles, long known to engineers, in its plan, if carried out, will make it the most extraordinary bridge in the world.

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* Address of E. S. Chesbrough, retiring President of the Western Society of Engineers. Reprinted from the *Journal of the Association of Engineering Societies.*

In regard to the deterioration of material in bridges, much and rather surprising information has recently been collected in this city, the particulars of which, it is hoped, will yet be published. Structures which were planned by able and competent engineers, with whom they were a specialty, have been found unsafe, from the effect of acids escaping from the furnaces of locomotives and other engines. Dangers of this kind, like many others, when expected are easily prevented.

The subject of sewerage, so intimately connected with the health and comfort of the inhabitants of cities and towns, has probably been written about more the last year than in any preceding one; but it is difficult if not impossible to point out anything in principle or essential features that was not known years ago to engineers familiar with this branch of their profession. The separate system, now about forty years old, has come into special prominence. It seems likely to be carried to an extreme, but will no doubt furnish valuable experience. In the disposal of sewage all the methods now resorted to have been known in substance, if not in minute detail, many years. The ventilation of sewers through perforated covers into the streets is now almost universally adopted, though strongly opposed not long since.

Although nothing new in principle in this department can be pointed out, much has been recently done in the planning and construction of new works, and in collecting information concerning the experience of cities that have had them for some time. Among our own countrymen, Mr. Hering has made an exceedingly valuable contribution to our knowledge by the recent account of his observations on the sewerage works of European cities.* It is expected that a completely illustrated edition of his report will soon become accessible to all. The experience of such cities as London, Paris and Berlin should be carefully studied by the engineer who would avoid serious errors in the planning of work for our own large cities. Yet there is much, and soon there will be more, to learn from experience in this country, especially in the disposal of sewage. Among works carried out for this purpose the past year are those of Pullman, so near us and the first of the kind in the West, and the most complete in the United States. From their operation it is believed much valuable experience will be gained for this vicinity, which has its peculiar climate and soil, while much of it, like Pullman, is very slightly elevated above Lake Michigan.

In many cases the engineer is perplexed in determining what to do to provide for future extensions. This difficulty is not confined to the planning of sewerage works, but is particularly troublesome with them. It is reported the lower parts of London suffer now from the flooding of cellars by excesses of storm-water not originally anticipated or provided for, but which are consequent upon the remarkable growth of that metropolis.

Paris is gradually extending her irrigating system by encouraging farmers to use the sewage, which they find so profitable. Berlin is making satisfactory progress with her extensive, but as yet partially carried out, irrigating system. Reports speak very favorably of the salubrious condition of the farms and value of crops raised upon them. It is believed that these will soon yield a sufficient net revenue to pay a reasonable profit on the cost of the farms, together with their improvement and maintenance, but not upon the cost of the works for delivering the sewage at the farms.

Contrivances for flushing and cleansing sewers are now more perfect than ever. For the improved sewerage of Boston extensive experiments have been made with cements.† One result was the curious as well as probably important discovery that a limited addition of pulverized clay to Portland cement increased its strength and imperviousness. If this should prove to be the case with other clays, and time show no deterioration in such mixtures, they will not only reduce the cost of Portland cement mortars, but add to their value for dams and reservoirs as well as sewers. A somewhat similar discovery is said to have been made at Providence several years ago, but the subject was not further investigated there.

The remarkable extent to which water-works have been introduced into the cities and towns of our country has been shown in regard to most of them by Mr. Croes, whose descriptions of their details‡ are already well known, and, like Mr. Hering's report, will make a very valuable contribution to our knowledge, and be a work of reference for many years to come. Such papers form a safe basis for progress, and it is well that some engineers of the requisite qualifications can find time to prepare them.

The new works for supplying Liverpool with water, commenced last year, it is believed are the most important now under construction. One or two facts in regard to them are of special interest. Besides tunnels and inverted syphons, now so well known, the reservoir which is to collect the supply is to be formed by a stone dam about 800 ft. long and 80 ft. high above the surface of the ground, and extending 40 ft. below to bed rock. Although stone dams are not new, even those of much greater height than the one at the head of the Liverpool works, they have not, in this country, been much in favor for considerable heights. Occasionally one has been recommended and adopted here, but the partiality for earth dams has generally prevailed, and in many cases is justifiable. But for very high dams, where a rock foundation can be reached, investigations in Europe and in the East Indies have settled the question that stone dams are much more advisable than earthen ones. The Furens and the Ban dams, in France, each about 164 feet high, have now been constructed long enough to add the testimony of experience to that of theory on this subject.

Another fact in connection with the Liverpool water-works is this: Nothwithstanding the saving of water brought about by the Deacon system in that city, her extensiva and costly new works have been commenced. This leads to a mention of the waste of water in cities generally; but there is not time to discuss it here. Yet there is nothing in connection with the management of works that calls so loudly for reform. Why cities should use from 50 to 125 gallons per inhabitant a day, when in the latter case two-thirds or more must be waste, is a very difficult question to answer on any reasonable or economical grounds, yet the attempts to prevent this waste are generally hedged about with difficulties that soon discourage or render powerless those who make them.

Hitherto electrical appliances have not been considered as coming within the special care of the engineer, but the field of invention they have already opened up has become exceedingly large, and covers a great deal that is inseparably connected with engineering works.

As a motor for locomotives or other engines, but little or no progress has been made in their general introduction except for those of very small power, to generate which steam must be used; but when water can be used, transmission of power by means of electricity to a distance will no doubt be rapidly developed hereafter. As by using the electric telegraph it is possible to do so much more business and with greater safety on railroads than formerly, so with the telephone all kinds of business are more rapidly and easily transacted between different parts of a city, and there is reason to believe this will be practicable before long between different cities. Already they have conversed through 600 to 700 miles of coiled cable, experimentally, and actually between the cities of New York and Buffalo—400 miles.

In the production of electric light we are often struck with new applications of beauty and brilliancy, especially in New York, Chicago and other cities, where some of the streets at night are made almost as light as day. By means of the electric fire alarm in Chicago, the time required to start horses and engine after the signal has been given has been reduced to less than eight seconds. Besides the rapid extinguishment of fires, electricity is proving a most efficient aid in the prevention of crime. The stranger or returning absentee is struck with the present efficient arrangement for massing police with great rapidity in any part of this city.

What to do with the telegraph and telephone wires has become a serious problem in American cities; the tendency to put them underground being on the increase. This is already done in European cities. In Paris, the sewers, which are much larger in proportion than in any other city, are utilized for this purpose.

The uses to which electricity has been and may be applied are so numerous already and increasing so rapidly that one is tempted to give strong play to his imagination in forecasting the future. By means of this wonderful agent Niagara Falls could be made to put out fires in New York and other cities; move the trains on many railroads, give light to millions of inhabitants and heat to their dwellings, besides accomplishing hundreds of other useful purposes. If the efforts now made by very able and hopeful men to store up this mighty and yet manageable force should succeed, it is impossible to set bounds to its uses. In some form or another electricity seems destined to enable men to navigate the air. When this is accomplished it will easy to do more in exploring the Arctic and Antartic regions in one year than has been done in a thousand hitherto. The geography of Africa will be known in a short time as thoroughly as that of Europe is now. It will then be possible, when commercial or other interests may require it, to make not only dwellings but clusters of houses comfortable and ornament them with tropical verdure the year round in the highest northern latitudes. Then may we reasonably expect to have a life-saving service along our coast that will, in connection with the telegraph, make it possible to rescue speedily the shipwrecked, and to snatch from the tops of burning buildings those who would otherwise perish. It is doubtful if the strongest imagination can equal the realities that are to burst upon us in the not very distant future of electrical appliances, which already surpass the dreams of but a few years since, which are rapidly bringing "the ends of the earth together," and breaking down the barriers that separate nations from the brotherhood a common humanity should lead us to cherish.

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* Reprinted in ENGINEERING NEWS.
† It is hoped an account of these will soon be published.
‡ See ENGINEERING NEWS.

CORRESPONDENCE.

WHY IS IT?

EDITOR ENGINEERING NEWS:

The correspondent asks: The radius of a 1° curve being 5,729.65 ft., why is not the radius of a 10° curve 5,729.65 + 10 ft.? Answer. The radius of a 10° is 5,729.65 ft. when distances on the line are measured on the arc. But the radius given in the tables for a 10° curve is calculated for distances of 100 ft. measured in chords, and as arcs are not proportioned to their subtending chords, the results would not be proportional, that is the radius of a 1° curve being 5729.65, the radius of a 10° curve would not be 5,729.65 + 10. A.

EDITOR ENGINEERING NEWS:

Your correspondent "Nimrod" asks the reason why the radius of a 10° curve is not exactly proportionate to the radius of a 1° curve. One would think that any person capable of asking such a question could answer it himself. The following formulæ may help him:

$$\text{Radius} = \frac{\tfrac{1}{2}\text{ chord}}{\text{Sin }\tfrac{1}{2}\text{ degree of curve}}$$

Example chord 100 ft.

$$10^\circ \text{ curve} = \frac{50}{.08716} = 573.6$$

Required radius. M. J. B.

HANOVER, N. H., April 29, 1882.

EDITOR ENGINEERING NEWS:

"Nimrod," in your last, asks why 5,729.65, divided by the number of the degree for which one wishes to find the radius, is not equal, I suppose, to required radius. If we let R = radius and a = angle at the center of the curve, subtended by a chord of 100 ft. or the degree of the curve (which in his first case would be 1° and second 10°) we could find R from the common formula $c = 2R \sin. \tfrac{1}{2} a$ where c in this case would be equal to 100 ft. From this we get $R = \frac{100}{2 \sin. \frac{1}{2} a}$.

Now, according to his reasoning, the sines of angles must vary as the angles, which is not true. For taking his example, viz., first, 1°, ½ of 1 will be 30 minutes, its sine .0087265; in second case ½ of $10^\circ = 5^\circ$, its sine .0871557, which is not ten times .0087265. The value of R in the above formula cannot be in the first case ten times what it is in the second.

If you remember that the angle made by a chord and tangent at any point is equal to one-half of the angle at the center subtended by the same chord, Art. 69 of Henck's Field Book gives the above formula.

I send you with this a circular, showing the present occupations of the graduates of our department of Dartmouth College, including the occupations also of our last three classes, which shows how many of them go into the engineering profession. I thought perhaps it might be of interest to you. J. V. HAZEN,
Prof. Theoretical and Applied Mechanics.

Following is the list above referred to showing occupations: Whole number of graduates, 291; number now living, 257; civil and mechanical engineers, 62; lawyers, 30; teachers, 22; physicians, 18; merchants, 23; railroad business, 5; professors, 6; college tutors, 1; chemists, 5; clerks, 8; farmers, 7; journalists, 3; clergymen, 4; draughtsmen, 3; cashiers and treasurers, 3; professor in U. S. Navy, 1; assistant engineer U. S. Navy, 1; member of Congress, 1; judge, 1; astronomer, 1; artists, 2; lieutenant U. S. Navy, 1; machinist, 1; publisher, 1; architects, 3; real estate agents, 2; private secretary, 1; mining engineers, 5; commercial traveler, 1; bankers, 2; undertaker, 1; unknown, 32.

Present employment of the members of the last three classes: Whole number, 46; civil engineers, 21; chemists, 3; draughtsmen, 2; law students, 2; college tutor, 1; clerks, 1; private secretary, 1; teachers, 3; farmer, 1; mining engineers, 2; medical student, 1; physician, 1; bank cashier, 1; manufacturers, 2; theological student, 1; student, 1; agent for manufacturing firm, 1.

SUSPENSION BRIDGES.

EDITOR ENGINEERING NEWS:

In your issue of April 22, you have a criticism upon my paper entitled "A New Theory of the Suspension System with Stiffening Truss," recently published in the Journal of the Franklin Institute, in regard to which I would like to say a few words.

You begin by asking the value of mathematical investigations based upon assumptions, when these very assumptions admit of question.

That is precisely the question suggested by my paper. I state clearly the assumptions of the ordinary theory. I point out that these assumptions are plainly incorrect, and I do my best to show how they may be dispensed with. To compare me in this connection with the theorist, who when informed of the facts, coolly remarks "so much the worse for the facts," seems to me rather unfair. In fact, I should say the boot was on the other leg. I say in effect, "look at the facts; they are not in accord with your theory. Would it not be just as well to make your theory with some reference to the facts?" You seem to me to say in effect, "deuce take your facts, *this is my theory*."

Now, the ordinary theory is this: The curve of the cable remains parabolic; the truss distributes the partial load and prevents the change of shape.

I answer in my paper, this is known *not* to be so. The curve of the cable does not remain parabolic, nor does the truss really so distribute the load. Who is here the theorist?

I then go on to show how we may proceed *without* making this erroneous assumption. To be sure the paper is couched in mathematical terms and formulæ. I couldn't help this. I would gladly have helped it if I could. But I couldn't. Really and truly, the higher mathematics are sometimes necessary, even indispensable. But then, you know, I was unfolding a "theory" for "theoretical men," and I think they will be able to tackle it, "bewildering" as it may seem. The very thought which led to my paper, abstract as it may seem, was, what in the world is the use of swearing by a "theory" which violates practical common sense in its very fundamental assumptions? I think you will agree with me that, whatever the value of my paper, this is working in the right direction.

You then notice the fact that I find the full "H" of the cable, according to the old theory, and you wonder what gain there can be, if, after all my work, I have to fall back on that which I condemn.

I would answer simply that we are dealing with two systems, cable and truss. *So far as cable is concerned* (these are the words of my paper), "H" can be found accurately enough by the old theory. A longer and even more "bewildering" discussion than I have given would not give "H" more accurately. So, like a sensible man, I didn't enter into that question at all.

But, *so far as the truss is concerned*, "H" is *only one* of the quantities which govern the strains in that. So my two equations "with three unknown quantities" may perhaps be of some value after all.

Then you speak of "rigidity." Now here, I think, you misunderstand me. By rigidity I don't mean lack of elasticity, but *freedom from undulations*. I don't think even Roebling himself would consider liability to undulations a very great advantage; at least, as I understand it, he inserted stays, partly at least, to break up these same undulations, and then not completely successful, he places stringent orders and regulations at the entrance of the bridge, as to character of load, speed etc., which these undulations will not permit.

Now, my theory differs from the ordinary in that it *finds the strains due to these undulations*, and that is just where I think you have misunderstood my use of the term "rigidity," and failed to see the point of my paper.

As to the stays, of which you make such a strong point, I would say, if you want them, *put them in*. Any careful reader of my paper will see that this is an unessential point of the theory. Proportion your system as though there were no stays, and then, if you want to, put in as many as you choose. I only say in my paper, what seems to me sound, that if *properly* proportioned without stays, I don't think you will find stays any advantage. The theory remains the same, whether you have them or not. They only seem to me an unnecessary addition to the properly proportioned system; a disturbing element; and I can't, I confess, see how they can answer any useful purpose. I can see the force of Roebling's remarks, which you quote, but those remarks were made concerning *his* system, and do not hold at all for that proposed. That is another point which I think has escaped you. I think in any of Roebling's suspension systems, if the material of the stays were put into the trusses and the trusses properly proportioned according to true theory, there would be a gain, not of rigidity in your sense, but of freedom from undulations in mine. Roebling put in his stays, by assuming a certain constant area of cross-section for all of them whatever their angle of inclination or wherever attached, and assuming they would take, all of them, a load equal to their safe load. He assumed that the truss acted simply to stiffen, and kept the curve of the cable intact. He assumed several other points equally questionable, and when I call these assumptions to account, it certainly does seem to me that I am not the man who says "so much the worse for the facts."

Finally, you refer to the good service of some structures in our midst "which bid fair to live down all cavilling" as an argument against any "new theory." I need scarcely point out to you that the safety of a completed structure is no argument at all. Good design lies, theoretically, in making the best use of your material, and practically in getting the best result for least cost. How far my theory may lead to the latter result I know not—nor do you. It needs to be tested, not necessarily by actual construction, but by comparison of strain sheets and bill of materials. As to the first, safety is no test at all. A structure may be perfectly safe and have in it blunders innumerable of design. The application of such a test and the careless acceptance of such a careless argument would put an end to all scientific progress in engineering construction. Yours very truly,

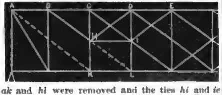
A. J. Du Bois.

METHOD OF REPLACING CHORD BARS.

Des Moines, Ia., April 27, 1882.

Editor Engineering News:

Would a truss, as shown in the figure below, be self-supporting supposing the dotted members



ak and *hl* were removed and the ties *hi* and *ie* added, also counter-struts between *ci* and *dh*. I say not, while several others think differently.

Assistant Engineer.

P. S.—The occasion for the problem came of the necessity of replacing two of the chord bars in the panel *kl*. The plan used consisted of ties from *k* to *b* and *d* while the change was made at *k*, and then from *i* to *l* and *e* while the change was made at *l*, the chord strain being taken up by long U-shaped rods around the piers on each side of the one where the change was to be made and their ends connected by turn-buckles. No difficulty was experienced in making the change. The parties making the change desired to use the other plan, because it would, if it would at all, have enabled them to make the change at both panel points at once, and without any change in the temporary trussing, etc.

A. E.

ELECTRIC LIGHTS FOR HELL GATE.

A BILL FOR MAKING THE GREAT WATER-WAY AS LIGHT BY NIGHT AS BY DAY.

Washington, May 2.—The House Committee on Commerce has favorably reported a bill making an appropriation for the establishment of electric lights at Hell Gate. It is proposed to erect two skeleton iron towers from 150 to 200 ft. high, one at Hallett's Point and one at Negro Head, on Ward's Island, or at such place as may be chosen by the Light-house Board. On each tower will be 10 lights, and the cost of the carbons consumed on each tower will be 20 cents an hour. One engine of 20 horse-power will do the work. The light shown from each tower will have a 20,000 candle power, and its full force can be concentrated upon that part of the passage which is most dangerous or difficult to navigate without affecting the vision of helmsmen or sailors. The committee says that from 80,000 to 100,000 vessels pass through Hell Gate every year, or a greater tonnage than leaves this country each year for Europe. For five years the Light-house Board has asked Congress for money with which to make experiments with the electric light, and the committee say that no better place than Hell Gate could be chosen for an experiment. The report was prepared by D. H. Richardson, of the Twenty-ninth Congressional District of New York, and it continues as follows:

We can, by the means suggested, make this important and crowded water-way safe at all hours of the night. At present, sailing vessels approaching the Gate at night are compelled to anchor until morning, and in consequence of this, at daybreak, when the large sound steamers come into the harbor, the channel is filled with sailing craft and the dangers of collision accordingly increased. The electric light at Hell Gate will avoid this blockade with its risks. It will enable the Sound steamers bound eastward, to leave New York at 6 o'clock in the winter as they do in summer, thereby saving from one to two hours. When established, many vessels will take the Sound instead of the outside route. There will be a saving of time and a lessening of danger. The increasing size of the Sound steamers and the multitude of passengers carried by them, and the rapid increase in the number of vessels, especially of the larger class, render it necessary that Hell Gate be made as safe by night as by day.

Commander Dewey, Naval Secretary of the Light-house Board, supports the position taken by Mr. Richardson of the committee. In his opinion such lights would prevent the jam which occurs every morning, caused by vessels which anchor off Riker's Island and Whitestone during the night to wait for daylight before going through. Not long ago 180 sailing vessels went through the Gate in the morning at one tide.

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NOTES.

Interesting to Water Takers.

Messrs. Newhall & Collins, shoe manufacturers, of Lynn, Mass., rented a portion of the block of John Wooldredge on Mt. Vernon street, and then asked the Public Water Board to let water in to said premises, which request was refused upon the ground, as alleged, that Mr. Wooldredge was in arrears of $80 for water supplied to that block. The shoe firm was given a hearing upon the matter, after which the Water Board voted not to let on the water. Messrs. Baldwin & Baker, attorneys for Newhall & Collins, petitioned the Supreme Court at Salem to command the Lynn Public Water Board to let on the water to their premises, the plaintiffs being willing to conform to all proper rules of said board. Counsel quoted several cases of a somewhat similar nature, and also the English case Wilkinson v. Sheffield Water Company in 1878, which closely resembled the one in question, wherein the plaintiff's prayer was granted. The Court, Judge Devens, granted the prayer of Messrs. Newhall & Collins, saying that the right to take water is a public right. One citizen cannot be made responsible for the debt of another without he assumes such debt.

General Manufacturing Notes.

The Boston Commercial Bulletin says: "Only about three-fourths of the pool sale of copper is sold for consumption; the other fourth of 5,000,000 lbs. goes into the hands of dealers who, of course, must make a profit. The chances are, therefore, that copper will rule ½ or ¾ of a cent higher than present prices. This, however, is the view of the mine owners. Metal dealers are of the opinion that not so much has been sold as reported, and that the price will decline rather than rise."

There are over $1,000,000 invested in the twenty-one glucose factories, with a capacity of 48,000 bushels of corn daily. The proportion of sugar is about four to one, thus giving a daily product in this country of 1,220,000 lbs.

Cotton manufactories are springing into existence at the South with great rapidity. Since the beginning of 1881 there has been an increase of 361,600 spindles, nearly one-third of this being in Georgia and South Carolina. The increase in spindles in the several States has been as follows: Georgia, 106,600; Alabama, 34,000; Tennessee, 24,000; Mississippi, 32,000; Louisiana, 21,000; North Carolina, 48,000; South Carolina, 96,000.

Coke making is a large industry in Western Pennsylvania. The soft, bituminous coal used is in the "Pittsburgh basin," southeast of the city of that name, and is found in a vein from 8 to 11 ft. thick, at various depths up to 800 ft., and is from 3 to 12 miles wide and 40 long. There are 8,000 "ovens" in operation, and the product last year was 2,760,037 tons.

The greatest single manufacturing interest in New York, says *The American Protectionist*, is that of clothing. There are 960 clothing factories, producing nearly $80,000,000 worth of goods per year. Next in number of establishments comes the cigar industry, with 751 factories, and an annual production of $18,000,000. There are 540 printing and publishing houses, which annually issues $24,000,000 worth of literature. The furniture manufacturers turn out yearly over $10,000,000 worth of goods.

Long Bridges.

Mr. K. Pfarski has made a list of the longest bridges at present existing, which are the following, their lengths being given in meters—about 3 ft. 3⅜ in.: Parkersburg Bridge, 2,147; St. Charles Bridge, over the Missouri, 1,993; Ohio Bridge, near Louisville, 1,615; bridge over the East River, 1,500; Delaware Bridge, Philadelphia, 1,500; Victoria Bridge, over the St. Lawrence, 1,500; new Volga Bridge, near Syssran, 1,485; Hollands-Diep Bridge, near Moerdyk, 1,479; bridge over the Pongabuda, near Gooty (India), 1,130; Dniester Bridge, near Kiew, 1,061; Rhine Bridge, near Mainz, 1,028; Dnieper Bridge, in Pultawa (Russia), 974; Mississippi Bridge, near Quincy, 972; Missouri Bridge, near Omaha, 850; Weichsel Bridge, near Dirschau, 837; Danube Bridge, near Stadian, 769; Po Bridge, near Mezzana Corti, 758; Tamar Bridge, near Saltash, 665; Leck Bridge, near Kullenberg, 665; Mississippi Bridge, near Dubuque, 536; bridge over the Goral River (India), 529; Britannia Bridge, near Bangor, 464; Saane Bridge, near Freiburg, 382; Theiss Bridge, near Szegedin, 355. The new Volga Bridge, near Syssran, is accordingly the longest in Europe.

THE HUDSON RIVER TUNNEL.

Work is progressing rapidly and favorably on the New Jersey side of the tunnel. The imperfection in the arch of one section of the brickwork near the second air-lock (described in Engineering News of March 11) has been repaired. This was effected by removing one plate at a time, excavating the silt until the plate could be readjusted at the proper grade, and then carrying over the brickwork. It was only necessary to remove the arch from the spring lines, as the remaining portion was perfect. But a few hours were required to bring the section—10 ft.—up to grade, when the alignment was as perfect as could be desired. The heading of the north tunnel is now about 950 ft. from the shaft.

The caisson at the New York end we described and illustrated in our issue of Dec. 24 last. This caisson was sunk in sand, which followed the water into the chamber upon the least reduction of the air pressure, and which presented a seemingly insurmountable barrier to all future progress; yet the main difficulties have been overcome most creditably, and the north tunnel is now on its way across the river.

Two or three days since we visited this portion of the work, and, after donning the regimental raiment, entered the air-lock and descended the iron shaft into the caisson. The masonry of the two tunnels has been completed up to the arch of the roof. In the caisson, at the New Jersey end, it will be remembered that the tunnels were united in one large chamber; but, in this case, the tunnels have been separated by a common central wall.

When everything was in readiness to cut through the river side of the caisson, auger holes were bored through and the wood-work chipped out and the top plates inserted, braces holding them securely in position. To keep the exposed portion from flaking, before the plates could be adjusted, wooden sheathing was held against it. The bottom of the tunnel was started as soon as the ring of plates was finished and then the sides and arch were built. At a distance of 12 ft. from the side of the caisson a bulkhead of iron plates was built and braced by struts resting against the caisson. This plan was due to the ingenuity of Chas. W. Clift, the Master Machinist of the entire works. This bulkhead will be moved forward, section by section, until the work is free from sand, and will be braced from the end of the completed mansonry. In order to prevent the escape of air, the joints and exposed portions of the heading are covered with a layer of silt brought from the other side. This renders the work practically air-tight, and has proved an economical and effective substitute for other materials calculated to accomplish the same results.

The masonry is 2 ft. thick, and is lined with compressed asphalte and limestone bricks 4×5×12 in. The seams are of pure Saylor's American Portland cement. This method of construction renders the work both air and water-tight, and if the brickwork be of ample strength, the fact that the bond between cement and asphalte is not perfect, and the fact that brick made of asphalte and limestone, although brittle when struck a sudden blow, will yield slowly to compression, are problems which in this case become of minor importance.

The exposed parts of the caisson have been covered with a layer of cement as a preventive against fire and decay.

The bottom of the tunnel is 56 ft. below mean low tide, and the air-pressure at the time of our visit was 17 lbs., and the temperature 84° F.

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ELECTRIC LAMPS.

If we examine one of the electric lamps in the streets we shall find it consists of two rods, one pointing upward from the bottom of the lamp, the other hanging downward. The rods seem to touch, and the brilliant flame is exactly where they seem to meet. Once a day a man comes around with a bag of the rods. He takes out the old rods that were burned the night before and places a new set in each lamp. After he has gone about, as if he were putting new wicks into the lamps, and each is ready for its night's work, all the lamps are lighted in broad day to see that everyone is in proper trim. They are allowed to burn until the men have walked about in the streets and looked at each lamp. If all are burning well they are put out till it begins to grow dark. If one fails to burn properly, a man goes to that lamp to see what is the matter. The rods are made of a curious black substance, like charcoal, that is called carbon. When the lamp is out, the two rods touch each other. In order to light the lamp, they are pulled apart; and if you look at the flame through a smoked glass, you will see that the rods do not quite touch. There is a small space between their points, and this space is filled with fire. Look at the other parts of the rods, or the copper wires that extend along the streets. They have no light, no heat, no sound. The wires are cold, dark and silent. If we were to push the two rods in the lamp close together, the light and heat would disappear, and the curious hissing sound would stop. Why is this? Let us go to the woods near some brook, and it may be that we can understand this matter.

Here is the brook, flowing, quietly along, smooth, deep, and without a ripple. We walk beside the stream, and come to a place where there are high rocks, and steep, stony banks. Here the channel is very narrow, and the water is no longer smooth and silent. It boils and foams between the rocks. There are eddies and whirlpools, and at last we come to the narrowest part of all. Here, the once dark and silent water roars and foams in white, stormy rapids. There are sounds and furious leaping and rushing water and clouds of spray. What is the matter? Why is the smooth, dark water so white with rage, so impetuous, so full of sounds and turmoil? The rocks are the cause. The way is narrow and steep. The waters are hemmed in, and there is a grand display of flashing white foam and roaring water-falls, as the waters struggle together to get past the narrow place.

It is the same with the electricity flowing through the large copper wires. It passes down one wire into the other, through the lamp, in silence and darkness, so long as the rods touch and the path is clear. When the rods in the lamp are pulled apart, there is a space to be got over, an obstruction, like rocks in the bed of the brook. The electricity, like the water, struggles to get over the hindrance in its path, and it grows white-hot with anger, and flames and hisses as it leaps across the narrow space between the rods.

There is another kind of electric lamp, used in houses; it has a smaller and softer light, steady, white, and very beautiful.

In these lamps, also, we have something like the narrow place in the brook. They are made with slender loops of carbon, inclosed in glass globes. The electricity, flowing silently through a dark wire, enters the lamp, and finds only a narrow thread on which it can travel to reach the home-going wire, and, in its struggle to get past, it heats the tiny thread of carbon to whiteness. Like a live coal, this slender thread gives us a mild, soft light, as long as the current flows. It seems calm and still, but it is enduring the same fury of the electricity that is shown in the larger lamps.

This is the main idea on which these lamps are made: A stream of electricity is set flowing from a dynamo-electric machine, through a wire, until it meets a narrow place or a break in the wire. Then it seeks to get past the obstruction, and there is a grand putting forth of energy, and in this way the electric force, although itself invisible, is made known to our eyes by a beautiful light.—*Charles Barnard, in St. Nicholas for May.*

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CONCERNING LAND SURVEYING.*

"Where are we?" is a question which must always interest persons of even the most ordinary experience and observation. It is answered by the surveyor and the engineer. The first answers this question by locating a point or line in space, with reference to a known place on the superficial area of the earth's surface, the second answers it by locating the same line or point, with reference to its position above or below the level of the sea, which great ocean plane is taken as the standard of the outside of the globe of the planet which we inhabit.

That delicate instrument which, acted upon by the force of nature, indicates the North, and in so doing designates all the other great courses of direction, is called the *mariner's compass;* but it might as well and as truly be called the landman's compass also. The surveyor and the engineer would both be often lost without it. It is difficult to conceive how mankind contrived to do without it, before its use and discovery. Yet it is very certain that the great Pyramids of Egypt, and many of the ancient temples of Greece, are built upon as true an alignment, with respect to the four chief cardinal points of direction, as any of the structures of the modern world. How this was done without the aid of those instruments now used for the purpose is only the subject of conjecture, a conjecture which has forced some of the thinkers to the conclusion that what we call *discoveries* are only re-findings of methods and instrumentalities well known before, but which once well known have afterwards perished and been lost sight of in the catastrophe of wars and revolutions so common to mankind. That the chief practical principles of surveying and engineering were known to the ancient world even in a high degree of excellence is well deduced from the remains of the Roman, Grecian, Assyrian and Egyptian roads, bridges, buildings and aqueducts. That some close attention had been given to land surveying at an early period in human history may be gathered from the course pronounced by the law of Moses, in Deuteronomy, against him "who removeth the ancient landmarks."

This anathema finds a place in the laws of our State and in all the modern cases of criminal jurisprudence; and it receives the heartiest approval of every one employed in the avocation of land measurement. The word survey is derived from the French verb *surveoir*, to overlook, and land surveying may be considered the earliest practical application of the art of geometry or earth measurement; and in some more or less rude form was coeval with agriculture and the division and appropriation of the soil. This science and that of geometry, which it involves, was cultivated by the Egyptians, at a very early period. Herodotus, the first authority on the subject, assigns the origin of the art to the necessity of measuring the land of Egypt for the purpose of taxation, in the reign of Sesostris, 1351 to 1416 before Christ, while Plato, Strabo and others charge it to the annual overflow of the Nile, and the consequent necessity of every year fixing the boundary lines of each land-holder's estate. And Diadorus tells us that the land surveyors of that day were composed of the sons of the priesthood. Euclid, sometimes called the Father of Geometry, was an Egyptian, being born in the city of Alexandria, 300 years before Christ, and his Elements of Geometry to this day is a text-book of the science.

Proclus, in his commentary upon Euclid's Elements, informs us that the art was brought to Greece by Thales, a great discoverer in Geometry.

In Rome, surveying was considered to be one of the liberal arts, and the measurement of land was intrusted to officers to whom were given certain privileges of considerable dignity. During the feudal ages this science was practiced with considerable accuracy, as an examination of ancient records and title deeds will show.

Land surveying may be divided into four classes, and defined as follows:

First. For determining the contents of areas or dividing tracts into lots of smaller dimensions.

Second. Topographical surveying, which includes, besides measurement of horizontal lines and angles, that of the variation of levels also, so that superficial inequalities may be geographically represented.

Third. Hydrographical or maritime surveying, the object of which is the determination of the position of channels, shoals, rocks and shore lines.

Fourth. Mining surveying for fixing the position of underground works in mines, so that these can be correctly mapped.

The simplest form of surveying is with the surveyor's chain. This chain is the invention of Edward Gunter, an English mathematician, who was born in Hertfordshire in 1581, and who died in London December 10, 1626. He was educated at Westminster school and at Christ Church College, Oxford, where he gave his attention principally to mathematics. In 1608 he invented the sector, a description of which was written by him in Latin and disseminated in manuscript. He afterwards took holy orders, but his tastes being entirely inclined to mathematics, he procured the chair of astronomy at Gresham College, which he filled until his death. His line, sextant and scale are still much used.

In connection with the chain, the compass is in common use in ordinary surveying. The Chinese appear to have been acquainted with the property of polarity in loadstone and in iron and steel magnetized by it, and to have been the first to apply this to science.

Dr. Gilbert, a high authority, states that the compass was brought from China to Italy by Marco Polo in 1260. There is evidence, however, of its having been in use in Syria, France and Norway before this time.

The telescope has also been made subservient to the use of surveying in some of its departments. The discovery of this wonderful instrument belong to one of two humble individual—Hans Sippenheim, a spectacle maker of Middleburg, or Metius, a native of Alkmarr. The former of these in October 22, 1608, presented his government with three instruments, with which, to use his own phraseology, one could see things at a distance, applying at the same time for protection, or the equivalent to a patent. Metius also made application later in the same month, but said he had manufactured the same instruments two years before. These wonderful instruments soon found their way to London, Paris and Venice. At the last-mentioned city they were seen by Galileo, who seized upon these inventions with the greatest ardor, and made such important improvements in their manufacture that they became almost identified with his name to the exclusion of the poor spectacle maker of Middleburg.

The office of county surveyor in the autonomy of Indiana is a very old one. It was created as early as 1819, with a few meager statutory provisions respecting its duties. It is a position which has never received either the attention or the compensation which its importance deserves.

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* Address of Hon. David Turpie, at the second annual meeting of Indiana County Surveyors and Civil Engineers, Indianapolis, Jan. 17, 1882.

In some of the States, as in New York, there is a Surveyor General, elected by the people, who has supervision by law of this whole subject, and of the local officers charged with its administration and the custody and control of all the original plats, maps and profiles first made in the work of surveying the lands of the State.

The duties of this office are now discharged, partially, in our State by what is known as the "Land Department" of the Auditor of State. But it is always in the hands of some subordinate of that office, and it may be worth while to consider whether the public interests would not be best subserved by the creation of a new officer, who should be specially charged with these important duties and others connected therewith, to be known as the "Surveyor General of Indiana."

Real property, as far as its separate ownership is concerned, depends upon, and is defined by, *metes and bounds*. Metes and bounds depend upon the *compass*. This instrument, the beau ideal of constancy, is itself, nevertheless, subject to what is called "magnetic variation" from the true meridian. The commission upon the revision of the laws reported to the last General Assembly, from very careful data furnished them by an able committee of Engineers and Surveyors, a provision in amendment of the present law. This provision required that the County Surveyor in each county, at or near the county seat thereof, upon a day named in every year thereafter, should establish, by a line of convenient definite length, the course of the true meridian, and mark at the same time the variation, keeping a record of such establishment and variation, and that instruments in use should be compared with and corrected by the measurements so ascertained. But in the haste and pressure of other business, either real or fanciful, of more importance, the amendment did not become a law. I trust that the attention of the legislative bodies may be again directed to this very interesting and important subject. Of course it will cost something to make these improvements in the present law, and to carry them into practical operation, but in my judgment it will cost much more not to make them.

The law of Indiana with respect to the survey of land, is yet somewhat meagre; it is not yet very definitely settled even by judicial decisions. A few general principles may be deduced therefrom, having been so often declared as to become axioms in this department. It must not be forgotten that as to points and lines upon the original subdivisions of the public lands, the duty of the surveyor is to find the points and corners as established by the survey of the United States government. These, when found, control the survey both as to course and distance, even although they may be mathematically inexact and erroneous.

Doe v. Hildredth, 2d Ind., 274.
Keesling v. Truitt, 30 Ind., 307.
West v. Cochran, 17 Howard, 414.

The United States survey controls every other. The federal government has invested the executive department thereof with all powers and jurisdiction as to the surveys of the public lands. Independently of the United States surveys, as fixed by the political power of the United States, litigants have no standing in any court. It is decided in our State that unequal surveys, made under authority of the government, must stand, and the monuments thereof must be followed, even although upon actual measurement a shortage appears, which shortage must be thrown to the north and west. These boundaries may, however, be controlled to some extent and changed by the agreement of parties, by a long term of acquiescence, or by what is sometimes called adverse possession.

Myers v. Johnson, 15 Ind., 261.
Ball v. Cox, 7 Ind., 453.
Evansville v. Paige, 23 Ind., 525.

The visible monuments of an old survey, whether natural or artificial, control measurements, distances, course and direction, even against actual mensuration and calculation. The result of an experimental survey, however accurate, is disregarded if it conflict with monuments of an old survey already established, however erroneous.

The rule that visible monuments control measurements and distances is a very valuable one, and would be more so if we could find them, or even determine the places with certainty where they stood. As to the latter point evidence is always competent if properly accessible.

Simonton v. Thompson, 55 Ind., 88.
Emmons v. Kiger, 23 Ind., 483.
Hedge v. Sims, 29 Ind., 574.

In the timbered portion of our State, trees were so abundant at the time of the original survey and so freely used, notched, blazed and corner-marked that it is comparatively easy to determine all lines and corners. And the same remark applies in the broken or hilly portions where stones and rocks abound. But in the prairie portions of our State there are vast tracts of land where neither a tree or stone could be found, and one may traverse miles and miles of the original plats without finding any other designation than "mound in prairie." No doubt the spot was marked plainly enough at the time of the old survey, but years have obliterated it so that it is very difficult, often, to distinguish these so-called "mounds" of the marker or rodman from the work of the ants, the mole or the muskrat. In such cases at present, much must depend upon the judgment, skill, patience and discernment of the officers engaged in retracing these old boundaries. But I would always advise a long, faithful and diligent search for the old monument, rather than the establishment of a new one, however much the latter might be verified by the results of an actual experimental survey made in these later times, because a discovery of the old landmark or the ascertainment of its location would invalidate the new one.

In addition to this it must be recollected that there is a vast number of lines and boundaries which although roughly drafted upon the original plats had in fact never been traced by the officers of the government at all. I refer now to what are called by surveyors meander or meandered lines, following the course of streams and rivers.

With respect to these it is held that the riparian owner, or the owner of the adjoining banks of a non-navigable stream owns the land along it to the thread or center of the stream; and this without respect to changes which may occur in it; and although the meandered portion may not have been included in the survey nor paid for to the Government. The Supreme Court of Indiana, say upon this subject: The Government was not selling her public lands only for the purpose of making money." * * * Her object was to induce the settlement in the country of a hardy land-owning people. Her surveys of the whole were more or less inaccurate, we know as a matter of fact and of general knowledge, that often sections exceed and often fall short of the quantity paid for even when what are called meandered lines are not concerned.

Ross v. Faust, 54 Ind., 471.

The inequalities and inaccuracies of original surveys must be expected, looked for and regarded. The first purchaser takes title from the Government for the tract included in the original survey and its meander lines, if there be such lines; be the same more or less as to the number of acres therein.

Indeed the system of United States Survey of lands leads unavoidably to certain inaccuracies. It is extremely doubtful if human wisdom be sufficient to prevent such a result under any system.

The law and the instructions concerning the survey of the public lands require that the lines forming the east and west boundaries shall be *true* meridians; they also require that the townships shall be *square*, six miles square, an impossible condition; because as the figure of the earth is not a true sphere, but spheroidal only, these meridian lines must converge toward the pole. The north line of a township must always be some shorter than the south, and this inequality increases as the survey advances to the north. The authors and administrators of the system admit this imperfection by providing, as has before been noted, that shortage shall be thrown north and west; and by providing in some of the States for the running of what are called "correction" lines, at an interval of every five or ten miles of northing.

The branches of science known as topographical and hydrographical engineering and surveying approach very nearly to the highest regions of pure mathematics. They deal very largely in the mensuration of areas, contents, spaces and distances by methods similar to those employed in calculating these elements in the solar and stellar world. Yet as all the various rules of arithmetic are said at last to be reducible to but simple addition and subtraction, so with these so-called superior departments of the science of surveying and engineering; they rest upon an ultimate basis of the simplest postulates.

This soaring philosophy all starts from the ground. From its low and humble perch upon the earth's surface, science mounts into the regions of the fancy and imagination, and converses with the suns and stars. Great improvements have been made, even in the last half century in the means and methods of surveying and engineering, but they are all in the same direction, they constantly propose the same *sum* to us, that is, to find out the *unknown* from the *known*. As familiarly illustrative of this, allow me to relate an incident in the life of one of the first land speculators and explorers who visited this continent. Sir Walter Raleigh has given name to the capital city of one of the States, and it is said among his other titles to distinction, that he was among the first persons to introduce the use of tobacco into England. Sir Walter, at this time in high favor with Queen Elizabeth, frequently indulged in the use of the odorous narcotic, by her request in her presence, as the whole operation was then very much of a novelty.

The knight, on one of these occasions, called her attention to the smoke gracefully curling from his pipe into the air, and made a wager of a purse of gold with her that he could tell its exact weight. Such a curious wager, readily entered into by the Queen in the spirit of banter, half jest and half earnest, which then characterized their intercourse, attracted general attention in court circles. A day was appointed for its determination. The Queen and a large company attended to see the result, many of whom, no doubt, gladly anticipated the defeat and discomfiture of the favorite in the royal presence. Sir Walter prepared himself very carefully upon the experiment. He brought with him a new porcelain pipe with a glass stem and a parcel of choice tobacco, with which he carefully filled the pipe bowl. The Queen, who sometimes amused herself with experiments in chemistry, had a very delicate and accurate pair of ivory scales with weights of gold. The knight took the tobacco out of the pipe, and with these scales weighed it, noting the weight very precisely in the presence of some ladies of honor, in waiting, who had been designated as judges in the matter in question. He then, with great care, replaced the tobacco in the bowl, lighted the pipe and, going into an adjoining veranda, commenced smoking. The vapor rolled away in fanciful clouds and eddies, and meanwhile a great deal of sport was made, at the knight's expense, at the notion of weighing a thing so subtle and intangible, and the more, because Sir Walter took no pains to prevent the escape of the fumes, but let them float away at random through the windows of the adjoining apartments and into the open air, whithersoever the wind carried them. Many a fair lady said, laughingly, as she inhaled a sniff of it; that she was confident she had got at least a pennyweight of it, and that the knight would surely lose his reckoning and his bet too.

He, however, continued very seriously and soberly to smoke his pipe until it was entirely exhausted and naught remained but the dead ashes. These he then very carefully took from the bowl, turned them into the same scales, and weighed them in the same manner as he had weighed the tobacco, subtracting then the weight of the ashes from that of the tobacco, he was enabled to give the exact weight of that which had escaped in vapor. The laugh would now have been turned in his favor, had the loser not been the sovereign. The Queen and all those present were pleased with the beauty and preciseness of the test. She cheerfully paid him the purse of gold, saying that he had fairly won the wager, and that his weighing of the smoke must now be set down among the other achievements which have made him so famous.

The great problem in science has always been, and yet is, to determine and ascertain the *unknown* from that which is *known*. The elementary truths in every department have been known to all mankind for many ages. But to determine from these clear, simple and self-evident as they are known and seen to be, those things which are not seen and not known; this is the task which humanity is always proposing to itself. The fall of the apple was an ordinary phenomenon, which must have been observed millions of times before Newton saw it. Yet from this known fact, deeply considered, the law of gravitation and of the courses of the heavenly bodies was all at last deduced.

The surveyor or the engineer will from measured lines and known angles upon one side of a river tell the width of the stream without crossing it, and by methods somewhat similar will determine the height of a crag or peak without ascending it. And in much the same manner, the distances and courses of bodies of the planetary world are ascertained, by the measurements, to begin with, of known base lines and the angles thereto incident upon the surface of our globe.

All the discoveries in science and inventions in art have had their beginnings in the known, and yet have carried their deduction as to the unknown to such marvelous extent as almost to seem supernatural. Moreover, we might thus proceed through the whole spacious realm of thought and action, to find only that the unknown is still much greater than the known—greater and yet more glorious.

CORRECTION.

In Engineering News, No. 17, April 29, in the article headed "Pavement of Cities," credit was given to the American Asphalt Pavement Co. for laying certain pavement in Washington City, D. C., which it seems was laid with the "Trinidad" asphalt, and the authorities cited and their commendatory opinions in favor of the asphalt pavements of Washington referred exclusively to the Trinidad asphalt as laid by A. L. Barber, Washington, D. C. In the same article, wherein Lieut. Greene's report is quoted, the word "Midland" occurs in lieu of "Trinidad." How this word became substituted does not appear. There is no such article as Midland asphalt, and reference is had entirely to the "genuine Trinidad asphalt" as constituting the pavement in Washington, which has been so highly commended.

CORRESPONDENCE.

WIND PRESSURE ON BRIDGES.

CAMP, W. & F. SURVEY, N. C.
April 30, 1882.

EDITOR ENGINEERING NEWS:

Professional engagements on surveys have debarred me from the pleasure of reading your valuable issues of this year until very recently, otherwise I should have noticed sooner Mr. Ward's reference to a former communication of mine. In his article on "Wind Pressure on Bridges," in the 4th of March number, Mr. Ward remarks that the two formulæ proposed for finding the vertical load thrown by the wind alone on one truss are equally accurate. Very true, provided the lever arm for the wind pressure on the cars is taken as suggested in my letter in ENGINEERING NEWS of Oct. 29, 1881, which, I infer, Mr. Ward has not done, for, as I understand him, he gives this lever arm as the "distance above top of stringer of center of gravity of rolling load = 8.1 ft."

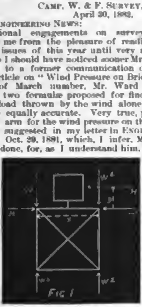


FIG 1

Now, as explained before, this distance or lever arm should be taken from the center of gravity of the wind pressure on the cars to the top of floor beam, if the stringers rest on the floor beam, or to near the top of connection of stringer and floor beam, where the stringer is placed between the floor beams.

This is evident, when we consider that the horizontal force of the wind on the cars can only be transmitted by the floor beams to the chords and thence to the abutments by the lateral trussing.

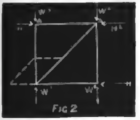


FIG 2

To appreciate this most clearly, we must consider every force that enters into the problem. Thus, in Fig. 1, H represents the force of the wind, per longitudinal foot, on the car surface. Now conceive two equal and opposed horizontal forces H_1 and H_2, each equal to H_1, acting along the floor beam; also the equal opposed vertical forces W_1 and W_2, W_4 and W_3 acting on the side trusses. This does not affect the previous status. Now if the forces W have such a magnitude that

$$Wx = Hy$$

then the couple H, H_1 is balanced by the equal couple W_2, W_1, leaving the horizontal force H_2 acting on the *floor beam*, the force W_1 acting as a vertical downward load on the leeward truss, and the force W_2, acting as a vertical upward load on the windward truss. The forces H_1, W_3 and W_4 represent the total resisting forces at the two abutments.

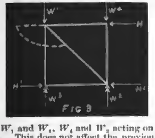


FIG 3

Now, if Mr. Ward has taken the lever arm if only to the top of the stringer, the excess weight thrown on the windward truss is certainly given too small in his stress sheets, which is to be regretted, as the exact percentages are of considerable interest.

If we take the stringers a foot and a half deep, the increase in the lever arm y, would increase the value of W_1, about 18 per cent. in this instance.

The action of the wind on the surface of the deck trusses may be understood from the following figures, where the forces are added in a similar manner to the above.

In Fig. 2 the truss is swung from top chords, in Fig. 3 from bottom chords, at the ends.

H is the part of wind force acting on the opposite chord to that which the bridge is swung; the part of wind force acting on the chord from which the bridge is swung is not shown, as it goes directly through the lateral system, of which that chord is a part, to the abutment. But H has to be transferred to the other chord through the diagonal tie, and thence to the abutments.

In both figures couple H, H_1 = couple W_2, W_1, leaving external forces H_2, W_1 and W_2, acting on the truss at the point considered.

In both figures H_1, W_3 and W_4 are the aggregate reactions at the abutments.

It is seen that in Fig. 2, W_1 lightens the load on the leeward truss, and increases it on the windward truss, whilst the reverse obtains in Fig. 3.

The combination of the maximum stresses due to W_1 and W_2 in Fig. 1, taken as live load, with those given by W_1 and W_2 in Figs. 2 and 3, gives the total effect of the wind on the deck trusses, acting as vertical load, and explains what Mr. Ward has called attention to, that the "disposition of the maximum stresses varies with the style of bridge."

We now come to a more important point. Shall the increased stresses due to the wind be provided for in the sections of the various members of a bridge, or shall we neglect them altogether?

As an individual opinion, I must agree with Mr. Gottlieb that if these stresses are to be considered, then because they are so rarely experienced, a smaller factor of safety can be used in finding the additional sections than for those stresses caused by every passage of a train.

Thus suppose 25 per cent. has been added to the section of the lower chord for the total wind load, taking the working stress at 15,000 lbs. per square inch, that for car and dead load being 10,000 lbs. per square inch. The average stress now per square inch is 11,000 lbs., which is certainly within bounds for this exceptional loading.

In a paper by the writer on "Maximum Stresses in Framed Bridges" (Van Nostrand's Science Series) the greatest stresses caused by exceptional loading were taken in designing the sections, using the same factor of safety for the exceptional as for the usual live load. This was not strictly accurate, as is brought to mind most forcibly now by the proposition to include other exceptional cases of wind loading under the usual factor of safety.

Experiment has shown that millions of repetitions of a certain load will sooner cause rupture than a few hundred applications of a greater load. This principle has received full recognition from American engineers in designing lateral bracing, and it is evident that it must be carefully attended to wherever exceptional loading occurs. Probably the simplest way for engineers and contractors to avoid the ever-recurring computation of this exceptional loading, of whatever character for every truss designed, is to tabulate once for all the increase in stress for various spaces for through and deck bridges and use these percentages as sufficiently near the truth for subsequent designs, at least where these percentages are appreciable in amount. As it stands, a great deal has to be borne by the factor of safety—so-called—and it is certainly well to diminish the amount to reasonable limits.

If the effects of temperature, friction at the joints and at the abutments, misfitting, etc., could all be tabulated in addition to the effects of the exceptional loads just considered, this factor of safety would be materially reduced and bridge failures should be rendered less frequent.

WILLIAM CAIN, C. E.

WHY IS IT?

FERRYSBURG, Mich., May 6, 1882.

EDITOR ENGINEERING NEWS:

On page 137 of the issue of your journal for the 29th ult. Nimrod asks "why is not the radius of a 1° curve, divided by ten, the radius of a 10° curve?"

This is not the first time this question has been asked, yet the answer is short and the remedy is simple.

We have not in practical use a suitable modulus for passing from the radius of one curvature to that of another. We use the chord of an arc of 1°, whereas we should use the arc itself.

It is well known that if we measure the radius of a circle with the developed arc of 1°, we shall find it to be 57.29578. If then we assume 100 units of any kind, as feet, links, etc., as the lineal value of an arc of 1°, the corresponding radius will be 5729.578 of those units.

It is also known that with a given amount of arc (lineal measure) the angle subtended will vary inversely with the radius. Whence, in the above-mentioned radius of a 1° curve, 5729.578, we have a correct modulus for passing from that radius to that of any other degree of curvature, and conversely, or by formula, representing by n°, the degree of curvature, we have the

Radius of an n° curve = 5729.578 ÷ n°, (1.)

and, conversely,

the curvature n° = 5729.578 ÷ radius, (2.)

From equation (1) a table of radii can be computed with as much facility as we would compute a multiplication table. Moreover, the two figures of any sub-chord would be the two decimals of a degree in the curvature. This last advantage would be well supplemented by an innovation already well introduced in some parts of the country, *i. e.*, by having one of the plate-verniers of the transit graduated to read the arc of 1° to two places of decimals.

It has been objected to this scheme, that the difference between the length of the arc, and the chord would introduce unwarrantable discrepancies into the work. This objection, I venture to say, has come from an incomplete consideration of the question, for it does not exist as a practical fact.

The chord of 100 ft. of the arc of a 4° curve is less than the arc by 1/3 in. The chord of 50 ft. of arc on an 8° curve is less than the arc by ¼ in.

With a 20-meter chain these discrepancies are less.

The following table shows the radii as computed from arc, and from the chord:

Degree of curvature.	Radius from 100 ft. of arc.	Radius from 100 ft. of chord.	Degree of curvature.	Radius from 100 ft. of arc.	Radius from 100 ft. of chord.
1°	5729.578	5729.65	15°	381.97	383.06
3°	1909.86	1910.08	20°	286.48	287.94
6°	954.93	955.37	25°	229.18	231.02
9°	636.62	637.27	30°	190.99	193.18
12°	477.46	478.34	35°	163.70	166.29

It is probable that of every ten practical men in the field, *nine* of them will pass from the radius of one curvature to that of another by an *inverse ratio*, though they know that the results are only approximate—using our present tables—and, notwithstanding the wonderfully concise formulæ of Henck for all questions of railroad curves. Why not use a scheme that will render this easy method *rigorously correct?* Rankine supposed we made use of this method of determining the radii from the arc of 100 ft. (See note on page 102, Rankine's Civil Engineering.)

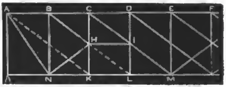
H. C. PEARSONS.

METHOD OF REPLACING CHORD BARS.

NEW YORK, May 9, 1882.

EDITOR ENGINEERING NEWS:

In the letter on "Method of Replacing Chord Bars," published in your issue of May 6, "Assistant Engineer" is wrong in his supposition that the truss in question would not be self-supporting under the given conditions. As long as the lower chord KL is not cut, any possible lack of stability would be produced by the changes in the web system. In this system we find in the figure that the strain in the vertical EM is carried to C as before by the diagonal MC; those in B and L instead of going up BL as before, now pass to I, and from there pass through the diagonal CI to I in common with the strain from the vertical EM. The strains in C and K which before went to A through diagonal AK now travel to H, thence through diagonal BH to B, then down B to N, from N to A through diagonal AN, and from A down end-post to the abutment. The directions taken by the forces show that the counters HD and IE are no more necessary than before, and they could be omitted without affecting the stability of the different parts. Roughly speaking, the strains in the modified system in CI, CH, BH, BN and AN are doubled, because in that part of the truss it is changed from a double to a single system.



Now if the lower chord had been cut in KL, as it was probably desired to do, the case would have been different. We would then have had a bending force at H in vertical CK, which would doubtless have caused a rupture at that point and a collapse of the structure. If though, instead of putting in the unnecessary counters IE and HD the piece NH had been inserted, of sufficient length, the truss would have been self-supporting for this case. For the strains in verticals and diagonals would have taken the same directions as before, and the strain in bottom chord would have been taken up by the pieces NH, HI and IM, leaving all the lower chord between N and M without any strain. This would permit any work to be done between those points which was necessary.

E. A. RUDIGER.

ENGINEERING NEWS.

GEO. H. FROST..............PROPRIETOR.
Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR. ....ASSOCIATE EDITOR.

SATURDAY, MAY 13, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17: six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—CONVENTION OF 1882, AT WASHINGTON, D. C.—The office of the local committee of the Secretary, and the headquarters of the Society during the Convention, will be at parlor 10, immediately at head of staircase, Willard's Hotel.

Members upon arrival will please register at the hotel office and report at parlor 10.

The arrangements, so far as perfected, are as follows:

Tuesday, May 16, 10 a. m.—Meeting for Organization; Selection of Officers of Convention; Announcement of Programme; Reading of Papers and Professional Discussions. 1:30 p. m.—Meeting; Reading of Papers and Professional Discussions. 3 p. m.—Visit to Capitol. 8 p. m.—Meeting; Annual Address, by Ashbel Welch, Esq., President of the American Society of Civil Engineers.

Wednesday, May 17, 10 a. m.—Visit to the Washington Monument. 2 p. m.—Meeting; Reading of Papers and Professional Discussions. 3 p. m.—Regular Meeting of the Society for the transaction of business. 8 p. m.—Meeting; Reading of Papers and Professional Discussions.

Thursday, May 18, a. m.—Excursion by steamboat on the Potomac; Examination of the Harbor of Washington and visit to Mount Vernon; on return, visit to the Washington Navy Yard. 8:30 p. m.—Reception by the President of the Society at Willard Hall and in parlors of Willard's Hotel.

Friday, May 19, 9 a. m.—Excursion to the Washington Aqueduct, Cabin John Bridge and the Inclined Plane, and Caisson connecting the canal and river at Georgetown. 1 p. m.—Reading of Papers and Professional Discussions.

There will also probably be included in the programme a call upon the President of the United States. Opportunities will also be afforded for a visit to the public buildings; for an examination of the intercepting sewer, the pavements and other works under construction by the District Commission; also a drive about the city of Washington.

In addition to the discussions upon papers referred to in a former circular, the following papers will be presented and discussed:

The Hudson River Tunnel: Gen. William Sooy Smith.

Description of some Experiments on the Flow of Water, made during the Construction of Works for conveying the Water of Sudbury River to Boston: A. Fteley and F. P. Stearns.

Underpinning under Water: A. G. Menocal.

Targets for Rifle Ranges: Capt. O. E. Michaelis.

Peculiar Phase of Metallic Behavior: Capt. O. E. Michaelis.

Accuracy of Measurement as increased by Repetition: S. S. Haight.

Highway Bridges: James Owen.

Reports will be expected from the Committees on Standard Time, on the Preservation of Timber, on Testing Cements, and those subjects will be discussed.

The proposed provisions for testing iron, steel and other structural materials will also be discussed.

THOS. LINCOLN CASEY, Chairman Local Com.
JOHN BOGART, Secretary A. S. C. E.

May 1, 1882.

AMERICAN INSTITUTE OF MINING ENGINEERS—PRELIMINARY ANNOUNCEMENT OF THE COLORADO MEETING.—The next meeting of the institute will be held in Colorado, beginning in Denver on Monday, Aug. 21, 1882. A week or ten days will probably be spent in the State. A subsequent notice will give the detailed programme of the meeting and the arrangements which may be made with railroad companies for excursion rates to Denver. It is necessary that the Secretary should have in good time the names of the members and associates who expect to attend the meeting, with the number of ladies who will accompany them.

It is desirable that there should be a large number of papers presented at this meeting, and members are requested to send the titles of their papers to the Secretary as soon as they can.

R. P. ROTHWELL, President,
27 Park Place, New York City.
RICHARD PEARCE,
Chairman of Local Committe, Denver, Col.
T. M. DROWN, Secretary.
EASTON, Pa., April 28, 1882.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its thirty-first meeting at Montreal beginning on Wednesday, August 23, under the presidency of Principal Dawson. The headquarters of the Association will be at McGill University. The circular announcement states that $1,260 have already been subscribed toward reprinting the earlier proceedings.

ACKNOWLEDGMENTS.

We are obliged to Supt. Felter, of the Binghamton Waterworks, for valuable items of news from that city; to J. E. Getchell, land surveyor, of North Vassalboro', Me., for a pamphlet containing tables of magnetic declination in that State from 1609 to 1880, with notes on the variation of the compass, the secular, the annual and the diurnal change; for the 13th annual report of the superintendent of streets and sewers to the city council of Springfield, Mass.

SEWAGE OF INLAND TOWNS AND CITIES.

The State Board of Health, Lunacy and Charity of the State of Massachusetts had submitted to them the question of the future sewering of the City of Worcester, Mass., in view of the probable pollution of the Blackstone River, and made a special report thereon, embracing a report of a project by Col. Waring, made to a committee of the town of Millbury, whose inhabitants, residents below the City of Worcester on the Blackstone River, were interested in the question as to the healthfulness of their locality; and also the project of a board of experts on the part of the State Board of Health, consisting of Dr. C. F. Folsom, Joseph P. Davis, C. E., of this city, and Dr. H. P. Walcott. The Board recommended the adoption of the plan of the latter gentlemen in preference to that of Col. Waring. The latter consisted in separating the dry weather flow of the sewage of the city and the early storm washings of the sewers from the water of Mill Creek, an affluent of the Blackstone, receiving at present about two-thirds of the city sewage, or 2,000,000 gallons daily. 2d. Allowing the earthy matters of the sewage to subside. 3d. To screen out the coarser objects. 4th. Expose the screened sewage in a thin sheet to the air during its rapid flow for a distance of 500 feet, in an open wooden conduit 20 feet wide, at a sharp fall (about 1 in 250). 5th. Carry it at a low velocity for about 10 miles through ditches, to be opened for the purpose, bordered by rank-growing trees or bushes—alternating from one to a second set of ditches as often as necessary, say once a week, so as to give each set a dry week for aeration of the subsided matters. 6th. To spread the resultant effluent over 126 acres of wooded swamp land, giving each area two days out of three for aeration. The total estimated cost being stated at $206,500.

The plan recommended by the State Board being that proposed by the experts above named, was briefly as follows:

The present population of Worcester is 58,300, with a yearly increase for each five years of a little over 20 per cent. The populated area of the city is 3,000 acres, of which 1,300 are already sewered. Total length of sewer, exclusive of Mill Creek, is 36 miles. Average rainfall, 48 inches.

The ground freezes from three to five months in the year to a depth of from 1 to 5 ft. The snow covers the ground from a few weeks to 3 or 4 months, from 1 to 3 ft. deep. The monthly average of temperature being on a mean 47° Fahr.

The dry-weather sewage of the city, as well as that proper to the valley of Mill Creek, is, by a separate system of sewers, brought to the intersection of this brook with Blackstone River. A pumping station located here elevates the city sewage about 7 ft., into a 42-in. conduit, which carries all the sewage to be dealt with estimated at 3 millions of gallons daily, for about 2 miles, to a small subsiding tank, beyond which an area of 75 acres is prepared by underdraining, etc., for the intermittent downward filtration, daily, of this amount of sewage, which method is recommended as the most suitable.

The estimate covers the expenses of thoroughly sub-draining the filtration land to a depth of six feet, the cost of leveling and preparing the surface, clearing and grubbing, and of building a complete system of carriers. It is as follows:

Separate system of sewers	$181,500.00
Pumping-station	17,500.00
Outfall-sewer, including iron pipe, etc.	55,300.00
Subsiding-tanks	9,500.00
Preparation of land for filtration	72,100.00
	$335,900.00
Add 10 per cent. for engineering and contingencies	33,500.00
	$369,490.00
Land and land damages	39.000.00
Total	$408,490.00

The estimated yearly cost of pumping is $3,500. This scheme is considered complete in itself, and makes ample provision for the purification of the sewage of Worcester; but should it be thought advisable to supplement it with broad irrigation, with a view to a more complete and better utilization of the sewage, the cost and preparation for irrigation, estimated approximately at about $100,000, should be added to the above estimate.

In calling attention as we have done to this decision of the Board of Experts it is that it offered an opportunity for a brief and well condensed exhibition of the principles and practices attending the generally received methods of utilizing city sewage, more particularly for inland towns. A very mistaken opinion exists as to the high value of city sewage for agricultural purposes, and very crude notions are occasionally advanced in favor of some money value being attainable under any and all circumstances, and which can scarcely be successfully combatted short of an exhaustive treatise of the entire subject, involving folios of experiments and failures. In this report the whole ground is covered and results alone stated, and by experts who, devoid of any personal bias, bring to the subject conclusions derived from long study and experience and great scientific ability. In the importance of extending the knowledge of this subject no apology is necessary for reproducing copious extracts from this report.

"For the purposes of this report, it is assumed that the dry-weather flow of the sewers of the city is at present 3,000,000 gallons per day, 2,000,000 gallons of which empty into Mill Brook above Cambridge street, and 1,000,000 gallons at Cambridge street. Twenty-eight hundred houses are connected with the present sewers; 4,000 houses are not connected. There are 26 woolen and cotton mills, besides a few iron works, saw mills, grist mills, a tannery with shambles on the river and its tributaries above the sewer outlet. About 50 gallons of the water supply are used per individual. * * * We have, therefore, 3,000,000 gallons of sewage to deal with daily, which the chemical analyses show to be about twice as dilute as the sewage of English towns, mixed with a brook, whose daily flow ranges from 1,000,000 to 40,000,000 gallons, not including extremes in a rapidly growing city.

"Mill Brook, with its accumulated sewage, empties into the Blackstone River at a point about three miles above the more thickly populated portion (the village) of the town of Millbury. The river flows parallel to and alongside of the main road connecting Millbury with Worcester, and at a point about midway is ponded by a dam. Here a considerable portion of the solids held in suspension are deposited, and a nuisance is created. In the town of Millbury are a number of dams, at each one of which some further deposition occurs; and along the whole course of the stream for some miles below Worcester putrefaction of the organic constituents of the sewage takes place (most rapidly in the summer months), and, as a consequence, offensive gases are liberated, which are largely the cause of complaint of this method of disposing of the sewage.

"The deposits undoubtedly stimulate and increase the growth of aquatic plants, and are thus, as well as by their own bulk, hastening the process of filling up the ponds. This, too, is a cause of complaint by the Millbury mill-owners. It is a belief of the people dwelling on and near the banks of the stream that a perceptible injurious effect upon the general health has been produced, and this belief is shared in, to some extent, by the resident physicians.

"That the stream at times is very offensive is quite evident, and that this, in connection with the gradual filling up of the ponds, will soon depreciate the value of property in its vicinity, unless some other than the present method of disposing of the sewage of Worcester is adopted, is beyond question. It should be stated, however, that a not inconsiderable portion of the pollution of the river below Millbury is contributed by the mills of that town situated on the main stream, and on Singletary Brook.

"The stream four miles below the sewer-outlet is unmistakably polluted; twenty-five miles down, the impurity is all but lost to chemical tests. At Millbury the water is unfit for the nicer manufacturing processes, and for boilers, and at times is decidedly offensive.

"Considering the extreme heat and cold of the climate, the heavy rainfall, and the great dilution of the sewage, the difficulties in the way of a satisfactory disposal of the sewage of Worcester are far beyond those of any other town where the question has already been met; so that any scheme that may be proposed may be said to be experimental to a certain extent; and to be successful, and not create a greater nuisance than it abolishes, it must be costly in the original outlay, and involve also a considerable yearly expense.

"Various methods of preventing the excessive pollution of streams have been adopted or experimented upon in England. They may be classified as follows:

"1. Simple subsidence in tanks.
"2. Chemical treatment or precipitation in tanks.
"3. Filtration through artificial filters.
"4. Intermittent filtration through natural soil.
"5. Broad irrigation.

"The first and third are very generally abandoned. They simply remove floating solids, leaving all the putrescible solubles to beget a nuisance when putrefaction begins.

"The second method produces an effluent which may be allowed to enter most streams that are not afterward used as a source of water-supply, and is one that a number of towns are constrained to adopt for want of land proper for filtration or irrigation. It removes all the solids, and a small percentage of the soluble elements; and the chemicals used in the various processes tend to fix the remaining putrescible elements in various degrees. Over sixty different precipitation processes have been proposed.

"The cheapest one is that known as the lime process, in which about one ton of lime is added to each million of gallons of sewerage of the English standard of dilution.

"The sewage is then allowed to flow very slowly through a series of carefully constructed tanks in which the floating solid matter, and that produced by the chemical action of the lime, are deposited, forming what is technically termed 'sewage sludge.' When the sludge has accumulated to a few inches in depth, the supernatant liquid is carefully drawn off, and allowed to flow over irrigation fields or into the neighboring stream. The sludge, consisting in this state of 90 per cent. of water, is removed (usually by pumping), and is finally disposed of in some way. After being exposed to the air for a year in the climate of England, it still contains 70 per cent. of water.

"It may be allowed to accumulate on the land, or it may be dug into the soil to serve as manure. It is usually given away, or sold (if possible) when partially dried. It is sometimes artificially dried at great expense, when its bulk is so reduced that it becomes a salable manure.

"In some towns in England the farmers pay a shilling or two a ton for the air-dried sludge at the leisure time of the year; in others they will not cart it away when given to them.

"There are many other chemicals than lime in use in the precipitation processes, many of which produce a slightly better effluent, and a more valuable sediment (if a comparison of the value of materials that are practically worthless may be made), and much less of it. In these respects they are to be preferred, but under most circumstances they are more costly. Where the sludge can be allowed to accumulate without causing a nuisance, the lime process will usually be adopted, although the effluent still contains a considerable greater portion of the putrescible element than in other processes.

"Where possible this effluent should, in all precipitation processes, be passed through the soil before entering the stream.

"For the treatment of the dry-weather sewage of Worcester we may assume, in the absence of actual experiments, that between two and three tons of lime per day would be required; that from forty to sixty tons of wet sludge, with 90 per cent. of water in it, will be produced daily; and that the cost, exclusive of interest on cost of works, would be from $10,000 to $15,000 per year. This is under the assumption that the sludge is allowed to accumulate or is given away. It is not probable that it could be sold unless first treated by some process, which would be at a loss.

"To create no nuisance in hot weather by any precipitating process is simply impossible, but the stench need not at any time be a serious matter to the town if the works are a mile or two distant. It can safely be said that nothing but a large expenditure originally, extreme care and a liberal appropriation each year, will prevent a nuisance from being established if this method be adopted. The resulting 'cleansed' water, not having removed from it the soluble filth, decomposes and creates offensive smells unless still further purified by running it over land in irrigation. The whole process is quite incomplete so far as purification of streams is concerned, and on account of its much greater expense than that of irrigation is justifiable only where something must be done and enough land cannot be got for irrigation.

"The fourth method, or that of intermittent filtration, is usually employed, when at all, as an auxiliary to broad irrigation.

"It consists, *per se*, in passing intermittently as large volumes of sewage through carefully prepared land as can be made to pass and produce a satisfactory effluent. In most cases, where any considerable area is acquired for the purpose, the net loss is diminished by cultivating crops, as that cannot be done where the greatest amount of sewage that can be filtered is used.

"The land, no matter how porous naturally it may be, is thoroughly underdrained; and to get the best results the surface must be shaped to level terraces. If crops are to be grown, it should be further prepared in ridges and furrows—the former for the growth of the crops, the latter for the distribution of the sewage to their roots.

Intermittent downward filtration has been adopted in Merthyr Tydvil in Wales; but it has been there abandoned in favor of ordinary surface irrigation and modified intermittent downward filtration, as no crops of value could be raised where the amount of sewage per acre (100,000 gallons daily) is so great. It is very seldom that land can be found porous enough for that method of disposing of sewage, there being only one town (Kendal, in England) where any considerable quantity of sewage (nearly a million gallons daily on five acres) is now treated to the full extent in that way. Intermittent downward filtration differs from ordinary sewage irrigation simply in the extremely porous character of the soil selected, in the great amount of sewage used per acre, and in the abandonment of any attempt to raise crops of any real value; although, by taking more land than was at first designed by Denton, the amount of sewage used to each acre may be so moderate in amount that excellent crops can be raised, and this has actually been the practice in several towns that have recently adopted intermittent downward filtration in England, of which Abingdon is perhaps the best illustration.

"The theory of the process is well described in the report of the English Rivers Pollution Commission, that such a filter is not a mere mechanical contrivance: it is a machine for oxidizing, and thus altogether transforming, as well as for merely separating, the filth of dirty water. A field of porous soil irrigated intermittently virtually performs an act of respiration, copying, on an enormous scale, the lung-action of a breathing animal; for it is alternately receiving and expiring air, and thus dealing as an oxidizing agent with the filthy fluid which is trickling through it. A sufficient extent and depth of porous soil having periodical intervals of rest, during which the soil drains itself, and becomes refilled with air, certainly must be the best possible strainer, oxidiser, and filterer of water containing nauseous organic impurities, both suspended and dissolved.

"At Quinsigamond there is an area of land fairly well suited for modified intermittent filtration of sufficient extent to dispose of all the sewage of Worcester. The results of this method, so far as the quality of the effluent is concerned, will be quite satisfactory; and, without doubt, the yearly loss will be very much less than with the precipitation process. If intelligently managed, the crops should partly repay the cost of labor and pumping, and possibly also in good years the whole of it, inasmuch as we propose distributing only 40,000 gallons of sewage to the acre, or one-fifth as much as is the practice in Kendal, but about twelve times as much as could be used in ordinary surface irrigation.

"The fifth method, or that of broad irrigation, is used with more or less modification, in varying degrees of efficiency, in nearly fifty towns of Great Britain, for about one-eighth of the sewage of the city of Paris, as an important part of the completed portion of the sewerage of Berlin, Stuttgart and Brussels, and for the disposal of the whole of the sewage of Dantzic in the porous beach-sand of the shore of the Baltic Sea. In no place is there a pecuniary gain from the operation where the sanitary portion of the problem is fairly solved. The yearly deficit varies in Great Britain from a few hundred dollars, or the value of the time of the person directing it, in small towns, to several thousand dollars in larger places.

"In Dantzic the contractors for the sewerage of the city were required, as part of their agreement, to dispose of the sewage by irrigation for a period of years. The sewage of Paris constituted from one-twelfth to one-fifteenth of the dry-weather flow of the Seine, being also unusually offensive and with an excessive amount of solid deposit, so that the nuisance was so great as to demand even a costly remedy.

"A light loam with a subsoil of gravel is best adapted to the purpose of sewage-irrigation, and 300 acres of it may be made to sufficiently cleanse 1,000,000 gallons of sewage daily. With that quantity, however, it would be often necessary to pour the sewage on the land when the soil was already wet enough, or even too wet, for the crops, so that agricultural loss would be the result; and in heavy rains it would not be always possible to purify at all the sewage, which would simply flow over the land to the nearest stream.

"With less than 800 acres of land to every million gallons of sewage, any crops but grass might be almost ruined in a wet season, unless the excess of water and some of the sewage could then pass into some stream; and it must be a matter of experiment whether there would be any nuisance in case of an extremely hot day following a long-continued rain. To fully satisfy the agricultural part of the problem, 1,000 acres should be provided for each one million gallons of daily sewage, although a fair result may be got with a far less area. At best, no one plot of land should be irrigated more than one day in eight in favorable weather. In time of wet soil any crops, except coarse grass of course, would be injured by pouring additional water upon the ground; and the quantity of coarse grass that can be raised on a sewage-farm with profit is limited to the amount that may be cut and fed fresh to live stock. A dairy farm is the best use possible of sewage-irrigated land, if it be near a large city where milk finds a ready sale.

"On an ordinary sewage-farm all crops may be raised. A large hotel in Paris is supplied with fruits and vegetables of the best quality from the sewage-farm at Gennevilliers, and, commonly speaking, the products of them find ready sale.

"All sewage-farms that are not managed with care are nuisances. There should never be excessive nuisance; and offensive odors can be avoided in the climate of England, as they can probably also be prevented here, if sufficient land is available.

"The best practicable treatment of the difficulty is upon the principle adopted for Paris; and this can be made satisfactory from all points of view, except that of profit. The plan consists in having a large tract of land upon which the sewage may be poured when that is for the advantage of the crops, and in being able to dispose in some other way of all that is not wanted on the farms.

"This other way in Paris now consists in dumping it into the river Seine. By the new plan it will be conveyed to an immense uncultivated tract of land owned by the State. Neither of these methods would be available for Worcester. We know of no other scheme so practicable as being able to provide for all the ordinary sewage by modified intermittent downward filtration, and procuring several hundred acres, upon which surface irrigation may be attempted, and extended from year to year.

"Whatever may be the means adopted to purify the sewage, the first step must be to separate it from the very great, but extremely variable, amount of water uniting with it in the brook, and to provide for the direct discharge of storm-overflows into the stream, thereby involving a considerable outlay of money in so changing the present sewerage system of the city as to fulfill these requirements.

"An exact comparison of the annual cost of the precipitating system and of sewage-irrigation is not practicable; the actual facts in these respects, wherever either has been adopted, having been almost always disappointing when compared with the estimates. The difficulties which must be met are new, and their cost must be decided largely by experience. Probably the annual loss by precipitation would be between ten thousand and five-thousand dollars. A favorable view of irrigation in Worcester would be that, in the best years, with skillful and economical management, there might be no loss beyond the interest on the cost of the works, and that at most the deficit can hardly be over six thousand dollars a year, pumping included.

"To properly dispose of the present sewage of Worcester by irrigation would require nine hundred or a thousand acres of land, which would need to be increased in the near future. Unfortunately so large an area of suitable soil conveniently located is not at command except by expensive pumping. We have therefore considered broad irrigation only in connection with modified intermittent filtration, and simply as a possible means, to be determined by experiment, of reducing the net yearly loss to the city in disposing of its sewage by the latter process.

"We therefore recommend, as the most practicable and least expensive method of disposing of the sewage of the city of Worcester, intermittent downward filtration upon so large an area (75 acres) that the sewage daily distributed per acre (40,000 gallons) will not be large enough to prevent the successful raising of crops. Ordinary surface irrigation may be applied by private parties so far as that may be of benefit to the crops; the filtering ground, however, always being sufficient to dispose of all the sewage, whether the farmers in the vicinity choose to make use of any of it or not."

RAWLINSON ON SYSTEMS OF SEWERAGE.

We have seen it stated by the advocates of the separate system in this country that Robert Rawlinson, the well-known English engineer, and author of "Suggestions as to the Preparation of Plans for Main Sewerage Drainage and Water Supply," was an advocate of the separate system of sewering in opposition to the combined. We take occasion to quote from an exchange a few paragraphs bearing upon this point, from a letter lately written by Rawlinson himself, and therefore presumed to be authority. The italics are ours:

"Sites vary so much, as may also other local conditions, that it will be impossible to formulate all points to be settled by similar questions. The thing, however, I utterly repudiate is the attempt to make a rule of three sum of the question of town sewering—as, for instance, given the area and the rainfall, and then asking of what dimensions shall the sewers be? It is well known that the fall of rain is irregular, and also that there are excesses which are overwhelming, especially in the tropics.

"But thunder showers outside the tropics can precipitate deluges of water for shorter periods, though the fall may not mount up to 30 in. vertical in 24 hours.

"If I must formulate for the tropics, which I have done, as for Calcutta, Bombay and Madras, I have said the heavier the rain the less in diameter the main sewers intended for house drains should be, so that in my opinion Col. Waring, at Memphis, has hit the right nail on the head. I however, insist on right lines, true gradients, side entrances, man-holes and lamp-holes, full ventilation, and the removal of roof water. Time and experience will show Col. Waring how far his first venture with small sewers and drains answers. *I shall not be surprised to learn that either he or his followers enlarge their sewers and take in roof and yard water.* * * *

"As to town sewering and house draining in general, I do not wish to be considered wedded to any special system, combined or separate. There are cases in which I would exclude surface water —I have done so; and there are cases in which I would take in surface water, as I have done; and as to the so-called causes of disease, by the growth of low forms of organic life, 'bacteria,' etc., in sewers and drains, I am contented to leave their study to medical men, chemists and microscopists. My aim is to construct sewers and drains of absolute truth in line, grade and sectional form' having smooth and vitreous surfaces, and to so proportion them to the flow of sewage and flushing that in work they shall remain absolutely clean. I then leave rats, bacteria, germs and other organisms to take care of themselves, as I *know by experience that such cannot find any abiding place in sewers and drains so constructed and so managed.* * * *

"There are, however, American experts who know far more about some of these things than I do. I can only refer to my suggestions on main sewering and draining as published and as adopted and practiced by the leading sanitary engineers of Great Britain—and, indeed, of Europe. There is not a suggestion put down which is not the result of out-of-door practical experience, and must not only be read superficially but must be studied to be fully understood.

"I have been complacently told by young engineers, after ten years' practice as Local Board Surveyors, that they were only beginning to see fully my meaning, and I fear some of the American engineers who have condescended to notice my works and suggestions have only done so superficially, and have, consequently, failed to grasp my full meaning. * * * I also find that original ideas are most complacently appropriated, in which there is nothing wrong, if the thief does not return them to you as his own.

"I make no claim to having either adopted or repudiated a combined or a separate system of sewers."

SUSPENSION BRIDGES.

We find much to commend in the paper by Professor Du Bois under the above heading in the last number of ENGINEERING NEWS, as indeed we do in any paper from his hand. With reference to this question of the usefulness or the contrary of stays to a stiffening truss, we admit, of course, that unless by a carefulness of adjustment, very difficult if not impossible to maintain in action, there can be no reliance upon any computation of strains due any stay or group of stays, and to attempt to apportion the relief to the cables afforded at all times, by simply estimating the sustaining power of the stays, is clearly an error, and not one that Mr. Roebling fell into, although a strenuous advocate for their practical value in long span bridges. With reference to the limit of flexibility at which such a structure may be said to possess anything like rigidity as understood by him, we should much like to hear from Professor Du Bois, and while we must take some of the intermediate steps of his calculus on his personal credit for truthfulness of application, we can appreciate the results to which he attains as of scientific interest.

LATHAM'S SANITARY ENGINEERING.

Several years ago we published a reprint of the above standard treatise on sewerage and sewer construction. Of the 3,000 copies printed less than 200 now remain; we have sent the sheets of these to the bindery and in a week expect the bound books to be returned. The price of the original English edition is $12; our American edition, bound in boards, is $8; the present, lot in cloth binding, we propose to close out at $1.50. This is not an abridged copy of the best treatise on sewerage that has ever been published in the English language, but is almost a *verbatim* reprint of the original edition, with the addition of other valuable matter on the same subject that cannot elsewhere be had. When all these remaining copies are sold, there will remain the few that are bound in boards at $3, which when sold closes out forever the cheap edition of this invaluable book, when the price will be stiff at $12 for the English edition. This opportunity once lost can never be regained, and the amount to be invested is so small that those who want the book cannot longer afford to be without it. We will send it post paid to any address on receipt of the money.

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BARGAINS.—We find that the accumulation of pamphlets, books, reports and exchanges of the past years are entrenching so largely on the space at our disposal that we propose to offer such of them as are of value to purchasers at such rates as cannot fail to be appreciated. We will be pleased to have book-buyers call and examine for themselves. The prices range from 0 to a premium on former retail rates of books now out of print.

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REPORT OF THE MICHIGAN ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.—We have received from the secretary of the above association a printed number of the above report. It is an octavo pamphlet of 56 pages, and the price is twenty-five cents, which may be sent in postage stamps. It is well worth the price. We refer our readers to a notice of it in a previous issue of this journal.

PERSONAL.

MR. SAYRES G. KNIGHT has been appointed city engineer of Racine, Wis.

COL. W. P. CRAIGHILL, of the United States Engineers' Corps, was in the city on Wednesday.

MR. O. N. LULL has resigned his position as Chief Engineer of the Cumberland Valley Railroad.

MR. C. C. HARRIS is Chief Engineer and General Superintendent of the Chicago & West Michigan Railroad.

IT is stated that Mr. James Ross, of Toronto, is to be tendered the position of chief engineer of the Canadian Pacific road.

JOSEPH O. OSGOOD has been elected Chief Engineer of the California Southern Railroad, with headquarters at San Diego.

W. R. GILLES is Chief Engineer of the Red River & Lake of the Woods Railroad, now being surveyed between Crookston and Fort Hilhiré, Minn.

COL. W. C. LEMERT, of Crawford County, O., has resigned the position of Chief of Engineers upon the Governor's staff, and Col. G. N. Gray, of Ironton, has been appointed to fill the vacancy.

MAJ. FRANK FANNING, Assistant Engineer Union Pacific Railroad, who has been in charge of the new shops being built at Grand Island for the past 18 months, has resigned to accept the appointment of City Engineer of St. Joseph, Missouri.

MR. JOHN ORTTON, formerly Mechanical Superintendent and latterly General Master Car-Builder of the Canada Southern Railway, has received the appointment of General Manager of the Portage, Westbourne & Northwestern Railway. His headquarters will be at Portage la Prairie.

EDWARD P. ADAMS, C. E., who has been for the past nine months engaged on the construction of the shops of the Northern Pacific Railroad at Brainerd, Minn., has returned to his headquarters, No. 178 Devonshire street, Boston, Mass.; his business engagements as a landscape architect in the East necessitating the change.

MAJOR G. J. LYDECKER, who has been designated by the President as Engineer Commissioner of the District of Columbia, to succeed Major Twining, is a son of John R. Lydecker, who was Deputy Collector under General Arthur in the New York Custom House. He has an excellent record as an engineer, and was for a time Assistant Professor of Engineering at West Point.

A WELL-KNOWN North country engineer, Mr. Charles MacNay (son of the late Mr. Thomas MacNey, of the Stockton & Darlingtan Railway) is about leaving Newcastle for Canada, to devote his professional skill to railway enterprises in that country. Mr. MacNay, though a comparatively young man, is not without Canadian experience, having been engaged some years ago on the Grand Trunk line.—From the *Newcastle Daily Chronicle*.

CHIEF ENGINEER GEORGE W. MELVILLE, who is making the hazardous and almost hopeless search for the missing boat and party of the Jeannette under command of Lieutenant Chipp, is a man of very striking appearance. He was born in this city, and in his young days his family was well known among the old Knickerbockers. He is a heavy-built man, weighing about 190 pounds, and is about five feet eleven inches in height. Of large and powerful frame, he is of light complexion, and has bright, piercing blue eyes. He is supple, and a skilled athlete. When he returned from the Arctic in the Tigress, in November, 1878, he visited the engineer's office in the Navy Yard, and when met by his brother officers the natural question was asked. "Well, George, how do you feel?" He answered, "As bright as a new uniform, and I never felt better;" and to prove his assertion turned a hand-spring without the least difficulty.

JEROME J. COLLINS, the meteorologist of the ill-fated Jeannette expedition, and who perished with Capt DeLong in the Lena Delta, was born at Cork, Ireland, October 17, 1841. His father, Mark Collins, a merchant manufacturer of the city, was a member of the Town Council for twenty-two years when he died, in 1863. At the Mansion House School, under the Fathers of St. Vincent, young Collins early manifested taste for the exact sciences, and when barely sixteen years old he became a pupil of Sir John Benson, the city and harbor engineer. He worked his way up rapidly; was made assistant engineer by the Corporation. In this capacity he had charge of the erection of a number of important works in the river and harbor, and in the case of the North Gate Bridge was publicly thanked and his name inscribed on the work where his statue may yet stand. But for his active spirit his native city did not offer sufficient opportunities, and he practiced his profession in England, where he made several railway surveys and had charge of important constructions in the midland counties. During the financial depression of 1866 in England he turned his face to the New World and took passage for New York. After some professional employment in the Union Pacific Railroad Company's office he was offered and accepted the task of directing the reclamation of marsh lands in New Jersey, near Newark. This important work was completed with great success in the fall of 1868. In 1869–70 Mr. Collins was Street Commissioner of Hudson City, N. J., where he resided. Shortly after he was appointed chief engineer of the Marsh Land Company, and subsequently was elected a director and became secretary. The temporary failure of this great scheme of swamp reclamation, in which he had unbounded faith, caused Mr. Collins to turn his attention to city surveying and general engineering practice, at the same time contributing to the daily press on many subjects, but particularly on meteorology, which had for some years attracted his close attention. The potentialities of a comprehensive weather service were a fascinating subject of speculation and experiment for him. Finally his journalistic leanings weaned him from engineering, and in 1875 he became regularly attached to the *Herald* editorial staff.

OBITUARY.

MAJOR WILLIAM J. TWINING, Engineer Commissioner of the District of Columbia, died in Washington on the afternoon of the 5th inst., of pleurisy, at the age of 42 years and 8 months. Major Twining entered the military academy, as a cadet from Indiana, July 1, 1859; graduated number four in his class in 1863, and was appointed first lieutenant in the engineer corps. He served in the department of the Cumberland till 1864, when he was designated as chief engineer of the department of the Ohio, with rank of captain and aid-de-camp. Subsequently, he served for a short time in the 23d army corps and in the department of North Carolina. He took part in the invasion of Georgia and in the operations against Gen. Hood in Tennessee. In August, 1865, he was appointed principal assistant professor of engineering at West Point, remaining there for two years, when for nearly three years he served as chief engineer, department of Dakota. After engineering services in the sixth light-house district, at Willet's Point, N. Y., in connection with boundary surveys, and also on the Union and Central Pacific railways, he was appointed on June 27, 1878, Engineer Commissioner of the District, having received the rank of major of engineers October 16, 1877. Major Twining was considered one of the most accomplished and capable engineer officers of the army. His duties in connection with the Board of Commissioners of the District were performed with such sagacity that he speedily won the respect and confidence of the citizens of the District. Socially, he was very popular, and those who enjoyed his intimate acquaintance will grieve for him as for a lost brother, for few men ever attracted to themselves so many warm friends. His worth as an officer was so highly estimated in the District that a proposition some months ago to transfer him to another field of duty, called out from the citizens of the District a vigorous and effective protest. The funeral took place on the 8th from St. John's church. Both the Distict committees of of the Senate and the House were largely represented, Senator Ingalls and Representative Neal both being present. The officers of the engineer corps, with Gen. Wright, were present in full uniform, as well as most of the prominent officials of the War Department. The army officers in their bright uniforms gave a touch of color to the somber groupings. The Russian minister and his secretary were present, and also the Secretary of War, Mr. Lincoln, and the Secretary of the Navy, Mr. Chandler, who represented the Cabinet. The President entered the side door unattended shortly before the hour and was shown to his usual seat. Judge Wylie and Judge Hagner were present as representatives of the District judiciary, besides the large individual delegations which attested to the personal popularity of the man as well as the appreciation of his services as a public official. The commodious church edifice was crowded; every seat was occupied, when the hour for the services began. The House District of Columbia committee on the 8th adopted resolutions "that we have heard with profound regret of the death of Major William J. Twining, late Engineer Commissioner of the District of Columbia; that in the death of Major Twining the District of Columbia has lost a faithful and intelligent friend, a most competent and judicious officer, who did his duty in all respects with a high appreciation of the present necessities and the future possibilities of the city of Washington; that the army of the United States has lost a noble comrade in arms, whose services during the late war commend his memory to the grateful recollection of the people of the United States; that the committee ever found Major Twining an intelligent officer and a judicious adviser in aiding them to shape the legislation of the District so as to meet the requirements of the people: that so far as our public duties will permit us we will attend his funeral, and thus bear testimony to the respect and esteem we entertained for him."

A general order was issued on the 8th by Gen. Wright, commanding the engineer corps, announcing the death of Major Twining, directing that the officers of the corps wear the usual badge of mourning for thirty days. After giving a sketch of his life, the order refers to his services as District Commissioner, and says: "To this office he brought unsullied integrity, sturdy good sense and executive ability of the highest order, and for nearly four years he has performed its duties with such rare skill and good judgment that his death is regarded by the community, whose affairs he administered, as a public calamity. Major Twining was distinguished for his gentleness and the strength of his character and his intelligent devotion to duty. No officer of his age has done more to sustain the high reputation of the corps of engineers, and his sudden death, in the prime of his usefulness, is to his brother officers a personal affliction, and to the corps a serious misfortune."

Adjutant-General Drum designated Lieutenants R. L. Hoxie and F. V. Greene to accompany the body to West Point as a guard of honor. He has also notified General Howard, Superintendent of the West Point Military Academy, that the Secretary of War has authorized the interment there, in accordance with the wish of Major Twining.

RECENT INVENTIONS.

CONCRETE PAVEMENT.

This improvement consists of a concrete pavement for roadways, laid in sections on a convex bed or foundation, and extending from curb to curb. It is provided with grooves running transversely across the roadway.

AERIAL NAVIGATION.

This novel air-ship has the balloon body made reefable, so that its lifting capacity will be variable. A horizontal or guiding sail is adjustably fixed below the balloon, so that it may be presented to the wind at any angle, whereby the ship may beat or back regularly in the air in vertical inclinations. The suspended car has one or more tanks containing a volatile liquid, and a retort for converting said liquid into gas. A vertical circular rubber is pivotally connected to the frame of the guiding sail, and is provided with a brace and steering lines, extending from the ends of said brace to the car. Automatic valves regulate the quantity of gas in the balloon.

EARTH AUGER.

This improved excavator consists of a screw-threaded and pivoted handle, carrying at its lower end two plates, the blades of which are disposed in slanting parallel lines, with the inner of those inclined upward abutting against the bar. Thus the inner edges of the upturned discs have a bearing against the edges of the cross-bar, whereby the discs are braced in the act of boring.

NOVEL JOURNAL-BEARING.

This important improvement consists of a hollow journal or journal box filled with liquid and firmly closed. The advantages which result from this construction are that the liquid acts as a non-conductor or equalizer, and thus prevents the overheating of the bearing. As the hollow journal or journal box is hermetically sealed to the air, the temperature of the bearing cannot rise above boiling point, as no water or oil can evaporate.

SHUNK'S FIELD ENGINEER.—We have 11 copies of the above which we offer till sold at $2 per copy, post-paid to any address. The regular price is $2.50. These books are direct from the publisher's shelves.

CONSTRUCTION OF GIRDERS.

Into a hollow iron shell is loosely fitted a wooden core, the shell having first been heated to a degree below redness. Melted pitch is then forced into the interstices. When cooled both are firmly cemented together.

NOVEL MOTOR.

In this improvement a series of radially arranged receptacles for volatile liquid are connected by tubes in pairs. Underneath the receptacles is a tank of warm water, in which the receptacles forming each pair dip alternately. An exterior jacket or casing is employed, which directs the warm air from a lamp or other calorific device around the sides and ends of said tank. This jacket or casing has in one end a door that opens for the convenient withdrawal of said tank. The receptacles are secured to a revolving frame by radially adjustable brackets connecting said brackets to the frames.

CRUCIBLE FURNACE.

This improved crucible furnace has a series of grate bars, the central ones of which being cast together solid at their center, and centrally hollowed out on their upper face. A block of refractory material is adapted to rest within the recessed grate-bars and receive the bottom of the crucible.

STEAM-ACTUATED VALVE

This improvement is designed for use in connection with a single-acting steam-pump, or high-pressure pump, having a single piston. It has two direct steam ports so arranged as to serve alternately as an induction port to the valve-plunger at one part of the stroke, and as an eduction port at another part of the stroke.

WASHINGTON, D. C. F. B. BROCK.

* * *

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 143.

CCXCIX.—WOBURN.

Woburn, Massachusetts, in lat. 42° 15′ N., long. 71° 10′ W., is in a hilly region, containing many natural lakes and ponds. Settled in 1640, it was incorporated in 1642. Water-works were built by the town in 1873, after plans of Henry M. Wightman, C. E., and under the superintendence of Clemens Herschel, C. E.

The supply is taken from a filter gallery 82 ft. long and 12 ft. wide. The side walls, 9 ft. high, are of rough stone laid without mortar. The gallery is covered with a semicircular brick arch. It was at first intended to take the water by a conduit, from Horn Pond, which has an area of 108 acres, a depth of 20 ft., and a water-shed of 7¼ sq. miles. In excavating for the pump well and conduit line, 100 ft. from the pond, so much water was encountered in the gravel that the gallery was substituted and no connection made with the pond. A 6-in. submerged centrifugal pump was first run for 7 days, a second one added for 24 days, and a 6-in. Andrews pump then added; but with these three running continuously the water could not be kept lower than 8½ ft. below the level of the pond. In the following spring, the contractor abandoned the work and it was successfully completed by the Water Commissioners. Two 18-in. centrifugal pumps, each driven by a 25 horse-power engine, kept the water down. One of these pumps ran continuously for 52 days, pumping 10,000,000 gallons per day.

A connection by pipe was made between the gallery and the pond, but it has never been used, the gallery supplying all the water required.

The average quantity drawn daily from the gallery for 8 years has ranged from 500,000 to 775,000 gallons. In the excessive drought of 1881, a daily draught of 1,000,000 gallons reduced the level of the water each day to near the lowest practicable point at which the pumps could work.

The water is pumped by a Worthington duplex pump, of 2,000,000 gallons capacity, erected in 1873, and a Blake pump of the same capacity erected in 1881. It is lifted 220 ft. into a reservoir built in excavation and embankment, on Horn Pond Mountain, 160 ft. above the town. The reservoir is 20 ft. deep, and contains 6,000,000 gallons.

Distritution is by wrought-iron and cement pipe of from 14-in. to 2-in. diameter, of which 36¼ miles are laid, with 271 fire hydrants, 194 gates, 1,418 taps and 38 meters. The town contributes $25 per year for each hydrant. Cement-lined wrought-iron and enameled-iron service pipes are used.

The population in 1880 was 11,024. The daily consumption in 1881 was 772,578 gallons.

The works have cost, to March 1, 1882, $322,550.77, and the total receipts have been $181,705.14. The bonded debt is now $387,293.16, with interest at from 6 to 4 per cent.

The expenses and receipts for four years have been as follows:

	Year ending March 1,			
	1879.	1880.	1881.	1882.
Cost of maintenance..	$7,393.30	$7,527.40	$10,398.61	$8,201.00
Receipts..	23,975.06	24,069.29	25,600.55	27,520.62

The works are managed by three water commissioners. Gilman A. Bean is the Superintendent.

CCC.—ATHOL.

Athol, Massachusetts, in lat. 42° 34′ N., long. 72° 18′ W., is in a rocky and broken country, on Miller's River, which affords extensive water-power. There are two villages. Water-works were built in 1876 for a private company, by S. L. Wiley, taking the supply from a mountain brook, on which an impounding reservoir of 20 acres area is formed by a dam of sand, with a stone masonry heart-wall, 14 ft. high and 600 ft. long. This reservoir is 500 ft. above one village and 400 ft. above the other. The water passing through a sand and charcoal filter, is conveyed through a 12-in. cast-iron pipe to two distributing reservoirs of one acre area each, 200 ft. lower down.

Distribution is by 11 miles of cast-iron pipe of from 12 to 4-in. diameter, with 50 fire hydrants, 19 gates, 300 taps, and 10 meters. The town pays $50 per year for each hydrant. Wrought-iron service pipes are used.

The population in 1880 was 4,303. The daily consumption is not known.

The capital stock of the company is $80,000. The works have cost $80,000. No further financial statistics are given.

S. L. Wiley is President of the company, and J. B. Cordary, the Superintendent.

CCCI.—ALAMEDA.

Alameda, California, in lat. 36° 50′ N., long. 121° 25′ W., is on level ground, surrounded by hills. It is chiefly occupied by persons doing business in San Francisco, 5 miles distant. It was settled in 1856.

Water-works were built in 1875 by R. R. Thompson as a private enterprise, taking the supply from 4 artesian wells, the flow from which is received in a well 30 ft. deep, whence it is pumped by two Worthington pumps (one low pressure and one high pressure for fire purposes) 110 ft. into a wrought-iron tank holding 250,000 gallons, placed on top of a brick building occupied for business purposes. The tank is 66 ft. above the highest point in the city.

Distribution is by 30 miles of cast-iron pipe of from 10 to 4-in. diameter, with 56 fire hydrants, 20 gates and 300 taps. Service pipes are of galvanized iron.

The population in 1880 was 5,705, and the daily consumption in 1881 about 250,000 gallons.

No financial statements are given.

Dell Linderman is the Superintendent.

CCCII.—BOULDER.

Boulder, Colorado, in lat. 40° 2′ N., long. 105° 6′ W., is at the eastern base of the Rocky Mountains, at the mouth of Boulder Cañon, on the creek of the same name.

Settled in 1859, it was incorporated in 1871. Water-works were built by the city in 1871, after plans of J. S. Titcomb, taking the supply from Boulder Creek, three miles from the city, and conveying the water about a mile in an open ditch around the side of the mountain to a reservoir formed by an excavation between two of the foot hills, with a masonry wall across the lower side. It is 150 ft. above the city.

From the reservoir the water is conveyed to the city by a cast-iron pipe of 10-in. diameter for 3,000 ft., and 8-in. for 8,000 ft. further, then branching into distribution pipes of 6, 4 and 3-in. diameter. Additional main pipes are to be laid in 1882. There are 6 miles of pipe with 37 fire hydrants, 18 gates and 400 taps. Service pipes are of galvanized iron and lead.

The population in 1880 was 4,000. The daily consumption is not given.

The works have cost $50,000, and the receipts have been $20,000. The bonded debt is $44,000 at 8 per cent. interest.

The works are managed by the City Council and a superintendent. This position is held by Samuel Piper.

CCCIII.—DE KALB.

De Kalb, Illinois, in lat. 41° 56′ N., long. 88° 42′ W., is on level ground on Kishwaukee Creek. Settled in 1836, it was incorporated as a village in 1851.

Water-works were built in 1876 by George C. Morgan for the village. The supply is taken from an artesian well 2,500 ft. deep and of 6-in. bore, the water from which is pumped 48 ft. by a windmill and auxiliary steam-power into a wooden

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tank holding 60,000 gallons, placed 65 ft. above the main street.

Distribution is by 1¼ miles of 6 and 4-in. cast-iron pipe and ¾ mile of wrought-iron pipe, with 17 fire hydrants, 6 gates and 64 taps. Wrought-iron service pipes are used.

The population in 1880 was 1,600, and the daily consumption 40,000 gallons.

The works have cost $34,000. There is a bonded debt of $8,000 at 8 per cent. interest. No further financial statements are given.

The works are managed by the fire committee of the City Council and the city clerk, S. O. Vaughan.

CCCIV.—CLARKSVILLE.

Clarksville, Tennessee, in lat. 36° 32′ N., long. 87° 18′ W., on the Cumberland River, is on a high bluff of white limestone and red clay, which is intersected by deep ravines. It was settled in 1785.

Water-works were built as a private enterprise by Travers Daniel in 1879, taking the supply from the Cumberland River, and pumping it by a Blake pump of 16-in. bore, 275 ft. into a stand-pipe 15 ft. in diameter and 102 ft. high on the highest ground in the city.

Distribution is by 5 miles of cast-iron pipe, of from 8 to 4-in. diameter, with 42 fire hydrants, 15 gates, 136 taps and 2 meters. The city pays $50 each a year for 40 hydrants. Lead and wrought-iron service pipes are used.

The population in 1880 was 5,010. The daily consumption is not known.

The works cost about $45,000. The bonded debt is $50,000, bearing 6 per cent. interest. No further financial statistics are given.

The works were managed by Travers Daniel until August, 1881, and since then by Fox & Smith.

T. H. Smith is the Superintendent.

CCCV.—COLUMBIA, TENN.

Columbia, Tennessee, in lat. 35° 48′ N., long. 86° 55′ W., is on Duck River, in a mountainous district.

Settled in 1819, it was chartered in 1848, and again in 1869.

Water-works were built about 1840 by the city, taking the supply from springs and pumping it 150 ft. into a brick and stone reservoir 20 by 80 ft. and 11 ft. deep, about 80 ft. above the city.

There are now in use a Cope & Maxwell pump erected in 1877 and a Dean pump erected in 1879.

Distribution is by 6 miles of 3-in. cast-iron pipe, with 2 fire hydrants, 6 gates and 120 taps, and 1 meter. Wrought-iron service pipes are used.

The population in 1880 was 3,400, and the daily consumption about 50,000 gallons.

The cost of the works is unknown. The annual expenses are about $3,000 and the receipts $1,500.

Henry Adkinson is the Superintendent.

The erection of new works is now under consideration.

CCCVI.—VIRGINIA CITY.

Virginia City, Gold Hill and Silver City, Nevada, in lat. 38° 42′ N., long. 119° 18′ W., are on the east side of Mount Davidson. Virginia City is 6,200 ft. above sea level; Gold Hill is in Gold Run, a dry ravine 2 miles distant, and 200 ft. lower; and Silver City is in the same ravine, 3 miles lower down. The city was settled in 1859. Before 1872 water had been obtained by tunnels driven into the side of the mountain. This supply having been exhausted water-works were built by a private company after the plans of Hermann Schussler, C. E., taking the supply from the Sierra Nevada, 29 miles distant. A dam of stone masonry 40 ft. high and 170 ft. long, forms an impounding reservoir on Hobart Creek, of 1,000 acres area. The water-shed is about 12 square miles, on which the annual snow-fall is over 20 ft. deep.

The water is conducted through 22 miles of plank flume 18 by 16½ in., with a grade of 20 ft. to a mile. Across Washoe Valley, between the Sierra Nevada and the Mt. Davidson range, the water is conveyed for 7 miles in two wrought-iron riveted pipes of 10-in. and 12-in. diameter, which at the lowest point are under 1,720 ft. head. The water is distributed from two reservoirs, one in rock excavation, 270 by 300 ft., and 15 ft. deep, 350 ft. above Virginia City, and one in earth excavation, 170 by 180 ft., and 8 ft. deep, 150 ft. above Gold Hill. Distribution is by 25 miles of wrought-iron pipe with screw couplings, from 4-in. to 1-in. diameter. There are 92 fire hydrants in Virginia City, 28 in Gold Hill, and 10 in Silver City. The number of taps is not given.

The population in 1880 was 18,705. The daily consumption is 4,200,000 gallons. The water is largely used for mills and mines.

The works cost $2,170,000. No further financial statistics are given.

J. B. Overton is the Superintendent.

[TO BE CONTINUED].

The receipt of statistics as follows is acknowledged with thanks: From S. O. Vaughan, City Clerk, statistics of the water-works of De-Kalb, Ill. From William J. Andrews, Mayor, statistics of the water-works at Columbia, Tenn. From T. H. Smith, Superintendent, statistics of the water-works of Clarksville, Tenn. From J. B. Overton, Superintendent, statistics of the water-works of Virginia City, Nevada. From Dell Linderman, statistics of the water-works of Alameda, Cal. From S. L. Wiley, statistics of the water-works of Athol, Mass. From G. H. Bean, Superintendent, statistics and water rates of the water-works of Woburn, Mass.

The circular sent to Blue Rapids, Kansas, being returned uncalled for, it is supposed that there are no water-works there.

Correction.—April 29, 1882, p. 135. *Bethlehem.* Beginning of third paragraph; for *an under conduit* read *a wooden conduit.*

May 6, 1882, p. 148. *St. Paul.* The water-works were purchased by the city on April 19, 1882.

INDIANA SURVEYORS AND CIVIL ENGINEERS.

The above association, which held its second annual meeting at Indianapolis on the 17th and 18th of January last, has just published its report. It is not a very voluminous document, as only an abstract of the business transacted and of the discussions is given. It publishes the constitution and by-laws and list of members of the Association. The officers for the year are: President, W. A. Osmer, of Cass County; Vice-President, P. C. Vawter, Tippecanoe County; Recording Secretary, J. B. Malott, Lawrence County; Corresponding Secretary, H. B. Fatout, Marion County; Treasurer, Isaiah Piatt, Legrange County; Executive Committee, Hervey B. Fatout, Indianapolis; John B. Malott, Bedford; Robert I. Morrison, Knightstown; Lewis S. Alter, Jasper; Ira McConnel, Crawfordsville.

There are 34 members. We publish elsewhere an address that was delivered at this meeting.

ENGINEERING COURSE CORNELL UNIVERSITY.

It is not necessary to dwell upon the advantages offered to the general student by the thorough course of study pursued at the Cornell University, but the register of the university for this year exhibits so complete preparation for the special study of civil engineering in all its branches that we are induced to call attention to the scope of instruction in this department, which may be extended to a five-year course, conferring the degree of Civil Engineer; the four-year course conferring the degree of Bachelor of Civil Engineering.

The instruction is given by means of lectures and recitations, with drafting, and field and laboratory practice. The field work embraces the usual operations and the more recent methods of land, railroad and subterranean surveying, together with hydrography and geodetic practice; and since 1874 the department of Civil Engineering has been engaged in the surveys of the hydrographic basin of Central New York, as a contribution to the geodetic surveys of the United States Government.

Laboratory practice is provided in chemistry, mineralogy, metallurgy, geology, physics and civil engineering.

The students of this department receive instruction in an extended course of mechanics, as applied to engineering, and their professional preparation comprises the following subjects: The location and constructions of railroads, canals and water-works; the construction of foundations, in water and on land, and of superstructures and tunnels; the surveys, improvements and defenses of coasts, harbors, rivers and lakes; the determination of astronomical co-ordinates; the application of mechanics, graphical statistics and descriptive geometry to the construction of the various kinds of right and oblique arch bridges, roofs, trusses and suspension bridges; the design, construction and application of wind and hydraulic motors; air, electric and heat engines, and pneumatic works; the drainage of towns and the reclaiming of lands; the preparation of plans and specifications, and the proper selection and tests of the materials used in constructions. As a part of their instruction, students have frequent practice in the preparation of papers on subjects of professional importance.

An elementary course of lectures is given in engineering and mining economy, finance and jurisprudence.

To meet the growing demand for special training, the five-year course has been arranged, allowing considerable option and diversity of studies to students wishing to pursue special lines of study in bridge architecture, or in railroad, mining, topographical, sanitary, geographical, electrical or industrial engineering.

The five-year course also offers lines of continuous study of a historical, literary or scientific character, which may alternate with the prescribed studies, and with architecture, general science and technology.

Equipment.—The special library of the department possesses many valuable works, among them the extensive publications recently presented to it by the French government; and in addition, the resources of the general library are available for the purposes of the department. The engineering laboratories contain various machines, models and appliances for engineering investigations.

The engineering museums contain the following collections, which receive regular additions from a yearly appropriation:

1. The Muret collection of models in descriptive geometry and stone-cutting.
2. The De Lagrave general and special models in topography, geognosy and engineering.
3. A nearly complete selection of the Schroeder models in descriptive geometry and stone-cutting, with some of the Olivier models, and others made at the University.
4. The Grund and Sohn collections of bridge and track details, roofs and trusses, supplemented by similar models by Schroeder and other makers.
5. A complete railroad bridge of one-hundred-foot span, the model being one-fourth of the natural scale.
6. The Digeon collection of working models in hydraulic engineering.
7. Several collections of European photographs of engineering works during the process of construction; and many other photographs, diagrams and models.
8. The following instruments of precision for astronomical purposes: a Troughton & Simms' transit, a universal instrument by the same makers reading to single seconds, 3 sextants, 2 astronomical clocks, chronographs, chronometers, 2 small equatorials, the larger of 4½ in. aperture, made by Alvan Clark, and other instruments necessary to the equipment of a training observatory.
9. For geodetic work, a secondary base-line apparatus, made under the direction of the Geodetic and Coast Survey Office, and all the portable astronomical and field instruments needed, including sounding machines, deep-water thermometers, heliotropes, etc.
10. Among the coarser field instruments there is nearly every variety of engineers' transits, theodolites, levels and compasses; such modern instruments as omnimeters, tacheometers, and tachometers, with a large number of special instruments, such as planimeters, pantographs, ellipsographs, arithmometers, pocket altazimuths and sextants, hypsometers, and meteorological instruments of all descriptions.

NOTES.

Railways in Brazil.

In January last there were 2,431 miles of road in operation and 2,009 miles in course of construction. The roads embrace some 20 or 30 short lines and branches connecting the principal seaport cities with interior trading points. There are no great trunk lines, but some of the road will, eventually, be extended into lines of great extent. About one-half of this railway mileage was built and is now owned by the government; another portion was built by private companies, the government guaranteeing the interest on bonds, and the balance was built by local subventions from the provinces and towns through which the roads run. The government guarantees are nearly all at 7 per cent. interest, and are placed in England.

The *Jornal do Commercio* states some of these roads are paying their guaranteed interest, and that the government liability is being gradually reduced.

The Sahara Sea.

The French appear to be seriously entertaining one of the greatest engineering projects of modern times—the creation, or rather recreation, of a vast inland sea, south of Algeria and Tunis, by the admission of the waters of the Mediterranean into a great basin of the desert by means of a canal about two hundred miles long. The Minister of Foreign Affairs, M. de Freycinet, has reported in its favor, and the President has appointed a commission of forty-eight to examine the scheme at once. The advantages anticipated from its execution are: a defense for the settled region against the invasion of the desert tribes, a considerable improvement of the climate in the immediate neighborhood, and the restoration to agriculture of considerable tracts of land surrounding the new sea; an easy means of closer communication with Central Africa, and the diversion to Algeria of a large part of the trade which now goes to Tripoli; and, finally, the provision of an impregnable retreat for the French navy in case, for any reason, it became unable to hold the sea in the Mediterranean.

Our Plat and Profile Book for civil engineers and contractors gives satisfaction wherever used. As an engineer writes us, "The better it is known, the more it will be wanted." It costs only *One Dollar* to test its convenience.

THE WASHINGTON CONVENTION.

The 4th annual convention of the American Society of Civil Engineers met according to programme (heretofore published), at Willard's Hall, Washington, D. C., at 10 a. m. Tuesday, 16th. The following members of the society were present:

Wm. M. Allaire, Engr. U. S. Electric Light Co. New York.

Edward R. Andrews, New York.

Geo. D. Ansley, City Engineer, Montreal, Canada.

A. Bonzano and wife, of Clarke, Reeves & Co., Phoenixville, Pa.

John Bogart, Secy. Am. Soc. C. E., wife and sister, New York.

A. P. Boller, New York.

G. Bouscaren, Cons. Eng. C., N. O. & T. P. R. R., Cincinnati.

H. D. Blunden, 1st Asst. Eng., N. Y., L. E. & W. R. R., New York.

Lyman Bridges, Ch. Eng. Cal. Central R. R., San Francisco.

L. L. Buck, Brooklyn, N. Y.

James D. Burr and wife, Lantry & Burr, Topeka, Kan.

Wm. H. Burr, Troy, N. Y.

Lt. Col. T. L. Casey, Corps of Engrs. U. S. A., Washington.

O. Chanute, Ch. Eng., N. Y., L. E. & W. R. R., New York.

S. H. Chittenden, East River, Conn.

Thomas C. Clarke, New York.

Amory Coffin, Engr. Phœnix Iron Co., and wife and Miss Reeves, Phœnixville, Pa.

Mendes Cohen, Baltimore, Md.

F. Collingwood, Ass't Eng. East River Bridge, New York.

Theo. Cooper, New York.

E. L. Corthell, Ch. Asst. Eng. N. Y., W. S. & B. R. R., New York.

J. J. R. Croes, New York.

Chas. Davis, County Engr., Allegheny Co., Pa.

Jos. P. Davis, Engr. Am. Bell Telephone Co., and sister, New York.

Fred. de Funiak, Gen. Man. L. & N. R. R. and Secretary, Louisville, Ky.

Alex. Dempster, Pittsburgh, Pa.

W. A. Doane, Asst. Eng. R., W. & O. R. R., Oswego.

John B. Duncklee, U. S. Ass't Engr., Washington, D. C.

T. Egleston, School of Mines, Columbia Coll., New York.

J. W. Ferguson, Asst. Eng. N. Y., L. E. & W. R. R., Hornellsville, N. Y.

Chas. A. Ferry and wife, New Haven, Conn.

Prof. R. Fletcher and wife, Hanover, N. H.

Clark Fisher, Trenton, N. J.

Sandford Fleming, Ottawa, Canada.

Edward A. Flint, Boston, Mass.

C. G. Force, Cleveland, Ohio.

C. E. Fowler, City Engineer, and daughter, New Haven.

James B. Francis and wife, Lowell, Mass.

John R. Freeman, Lawrence, Mass.

A. Fteley, Chief Asst. City Eng., Boston, Mass.

Chas. E. Goad, Montreal, Canada.

A. Gottlieb, Pres. Keystone Bridge Co., Pittsburgh, Pa.

Fredk. Graff, Hydraulic Engineer, and wife, Philadelphia, Pa.

Gen. Geo. S. Greene and wife, New York.

S. S. Haight, Asst. Eng. Dept. Pub. Parks, New York.

Wm. G. Hamilton, Pres. Hamilton Steeled Wheel Co., Vice-Pres. Central & S. A. Telegraph Co., New York.

James H. Harlow, Eng. Monongahela Navigation Co., and wife, Pittsburgh, Pa.

Wm. P. Harris, Supt. H. Div. C. & O. R. R., Huntington, W. Va.

Clemens Herschel, Hydraulic Engineer Holyoke Water Power Co., and wife, Holyoke, Mass.

Albert B. Hill, Asst. City Engineer, New Haven, Conn.

Thomas C. Keefer, Ottawa, Canada.

John Kennedy, Chief Eng. Harbor Commis'rs, Montreal, Canada.

Louis Lesage. Supt. Water-Works, Montreal, Canada.

G. P. Low, Jr., Supt. Road Dept. E. C. & N. R. R., Norfolk, Va.

Wm. H. Lotz, Chicago, Ill.

Capt. O. E. Michaelis, Corps Ordnance U. S. A., Philadelphia, Pa.

D. E. McComb, Asst. Eng. Dist. Comms., Washington, D. C.

Thos. C. McCollom, Civil Engineer, U. S. N., New London, Conn.

T. H. McKenzie, Southington, Conn.

George W. McNulty, Asst. Eng. East River Brdge, Brooklyn, N. Y.

D. N. Melvin, Cons. Eng., and wife, Staten Island.

Geo. S. Morison, N. Y.

Alfred Noble, Gen. Supt. St. Mary's Falls Canal, Sault Ste. Marie, Mich.

J. A. Ockerson, Asst. Eng. Miss. River Com., St. Louis, Mo.

L. T. Olney, Res. Eng. M. Branch N. R. R., Middletown, N. Y.

S. C. Pierson, City Surveyor, Meriden, Conn.

Geo. H. Pegram, Ch. Eng. Edge-Moor Iron Works, Wilmington, Del.

F. C. Prindle, Civil Engineer U. S. N., Brooklyn, N. Y.

Jos. W. Putnam, New Orleans, La.

Wm. W. Reid, Erie, Pa.

David Reeves, Pres. Phœnix Iron Co., Phœnixville, Pa.

Joseph R. Richards and wife, Boston, Mass.

Thomas F. Rowland, Continental Iron Works, Greenpoint, N. Y.

Wm. H. Searles, Newburgh, N. Y.

R. A. Shailer, Asst. Supt. Edge-Moor Iron Co., Wilmington, Del.

T. P. Stearns, Asst. Eng. Imp. Sewerage of Boston, Atlantic, Mass.

J. G. Van Horne, wife and sister, Jersey City, N. J.

Ashbel Welch, President Am. Soc. C. E., daughter and niece, Lambertville, N. J.

Ashbel Welch, Jr., and wife, Lambertville, N. J.

C. D. Ward, Jersey City, N. J.

L. B. Ward, Jersey City, N. J.

Prof. H. F. Walling, U. S. Coast Survey, Washington, D. C.

John W. Weston, Chicago, Ill.

D. J. Whittemore, Ch. Eng. C., M. & St. P. R. R., Milwaukee, Wis.

Wm. H. Wiley, New York.

Wm. E. Worthen and wife, New York.

President Ashbel Welch called the meeting to order, and Col. T. L. Casey, U. S. A., in the absence of Gen. Wright, Chief of Engineers, U. S. A., who was confined to his home by sickness, was elected permanent chairman. Col. Casey welcomed the society in a few brief remarks; he referred to the scarcity of engineering works of great interest in Washington, but mentioned the water-works, which included an aqueduct with the largest span stone arch known to exist; there was the underpinning of the Washington monument, and also the harbor and the well advertised flats which have furnished the District doctors with a good text for many years; the insufficient water supply was also mentioned, and to the above and other matters the attention of the engineers was invited.

Secretary Bogart then announced the programme of the sessions. This was published in full in this journal last week, and the only change in the printed programme distributed to the members by the local committee is that on Saturday an excursion to Pen-Mar was arranged, and so timed as to enable members to reach New York by 10.20 p. m. same day. This programme we may be certain was well carried out under the supervision of the very able local committees. The first paper read was by Capt. O. E. Michaelis, on "An Instance of Zymotic Disease in Metal." The annual address of the President was delivered on Tuesday evening; on Wednesday morning Washington monument was visited and the different stages of the work were explained by Col. Casey, to whose intelligent designing and superintendence the success of the work is due.* At the afternoon session the Committee on the Preservation of Timber made a verbal report, which was followed by a brief discussion.

A report was then read upon the subject of standard time by Mr. Sandford Fleming, of Ottawa, Canada, chairman of the committee appointed by the Society at its meeting in Montreal to take into consideration the whole question of standard time. At the annual meeting of the society in New York on Jan. 17, the committee made its first report, submitted a scheme for the establishment of a prime meridian and of uniform standard time, and suggested the expediency of obtaining "an expression of opinion upon the various points which presented themselves from as large a number of practical and scientific men as possible." This suggestion was approved by the society, and the committee was further authorized and requested to take such steps as might be necessary to obtain information which would enable it to report definitely at a future meeting. The committee thereupon prepared a series of questions to cover the whole subject, and sent copies of it, together with printed copies of the scheme proposed for the establishment of standard time, to a large number of persons throughout the country who are directly and practically interested in the question. By the scheme referred to it is proposed:

First. To establish one universal standard time, common to all peoples throughout the world, for the use of railways, telegraphs and steamboats, for the purposes of trade and commerce, for general scientific observations, and for every ordinary local purpose.

Second. It is proposed that standard time everywhere shall be based on the one unit measure of time denoted by the diurnal revolution of the earth as determined by the mean solar passage at one particular meridian to be selected as a time zero.

Third. The time zero to coincide with the initial or prime meridian to be common to all nations for computing terrestrial longitude.

Fourth. The time zero and prime meridian of the world to be established with the concurrence of civilized nations generally.

Fifth. For the purpose of regulating time every where it is proposed that the unit measure, determined as above, shall be divided into 24 equal parts, and that these parts shall be defined by standard time meridians established around the globe, 15° of longitude or one hour distant from each other.

Sixth. It is proposed that standard time shall be determined and disseminated under governmental authority; that time signal stations be established at important centers for the purpose of disseminating correct time with precision, and that all the railway and local public clocks be controlled electrically from the public time station, or otherwise kept in perfect agreement.

Seventh. The adoption of the system in the United States and Canada would, exclusive of Newfoundland and Alaska, have the effect of reducing the standards of time to four. These four standards, precisely one hour apart, would govern the time of the whole country, each would have the simplest possible relation to the other, and all would have equally simple relations to the other standards of the world.

Finally. It is proposed to have only one series of hours in the day, extending from midnight to midnight and numbering from 1 to 24, without interruption, to number the hours between midnight and noon (1 to 12) precisely as at present, and to denote the hours between noon and midnight by letters of the alphabet.

To the series of questions which accompanied this scheme the committee has received hundreds of replies, and Mr. Fleming, in his report to the society, gave a classified statement of their purport, as follows: Ninety-seven per cent. of all the writers approve the scheme; 76 per cent. express themselves as in favor of four standard meridians in North America, one hour, or 15°, apart; 6 per cent. favor two meridians, and a small minority prefer one continental meridian. In reply to the question with regard to a change in the notation of the hours of the day, a very large majority of the committee's correspondents—92 per cent. of the whole number—express themselves in favor of counting from 1 to 24 consecutively. In conclusion Mr. Fleming said: "Upon the replies received to its questions, the committee is fully warranted in reporting that there is throughout the country a very strong sentiment in favor of establishing a system of standard time upon the basis of the scheme which the society now has under consideration. The report of the committee was approved by the society, and resolutions were adopted requesting Congress to take the initiative step by endeavoring to establish a prime meridian which shall be common to all nations.

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* A full and illustrated description of this remarkable feat in engineering is published in Engineering News, Feb. 7, 1880.

The solemn ceremony of being "received" by the President, which is the "regular thing" to do in Washington, was performed by the members at 4 p. m. "by appointment."

At the evening session Mr. A. G. Menocal' U. S. N., read a paper on the Reconstruction of a Quay Wall at Norfolk, Va. Papers were also read on Tests of Structural Material, and the Overflow of the Mississippi. The report of the Committee on Standard Time favored basing it on the one unit measure of time denoted by the diurnal revolution of the earth as determined by the mean solar passage at one particular meridian.

On Thursday the members made a visit to Mt. Vernon, and on their return stopped at the navy-yard, and then continued up the harbor and inspected the flats. In the evening the President of the society gave a reception at Willard's.

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OHIO INSTITUTE OF MINING ENGINEERS. —NELSONVILLE MEETING.

EDITOR ENGINEERING NEWS:

The Ohio Institute of Mining Engineers met in Nelsonville, Athens County, on Thursday last, and after a profitable session of two days adjourned to meet in Youngstown in October next.

Nelsonville is one of the oldest mining towns of the Hocking Valley, and is pleasantly situated on the left bank of the Hocking River. The Ohio Canal also passes through the village, which, completed from Columbus to Athens in 1833, was for years the great coal carrier of the valley. Now the Columbus & Hocking Valley Road does most of the coal business, shipping annually one and a quarter million tons. The mines are mainly located below the village of Nelsonville, on the Hocking River, though the extensive mines of Peter Hayden are situated 5 miles above Nelsonville, and the mines of W. B. Brooks & Sons are opened on both sides of the river in the immediate neighborhood of town. Just below town are the mines of C. L. Paston & Co. and T. Longstreth, for many years opened and worked. There are a number of new plants around and below town, and on Monday Creek, the largest and most important of which are the mines of the Akron Iron Company, which has a blast furnace alongside of the mines; the mines of the Hocking Iron Company at Orbiston, which has also a blast furnace. These furnaces are large, well-built structures. The whole valley is covered with mines end blast furnaces. It can, with propriety, be called the Black Country of Ohio, upward of one-third the coal production of the State being drawn from this region alone.

A number of the visiting engineers to Nelsonville session visited the mines on the afternoon of Thursday to examine the Harrison coal cutting machines in use in Brooks' mines, and all Friday was devoted to an inspection of the leading mines of the district. There were two sessions of the engineers, at the first of which five papers were read by members—one by Prof. Edward Orton, State Geologist, on the "Lower Coal Measures of Ohio;" one by J. G. Chamberlain, on the "Social Condition of our Working Miners;" one by P. M. Hazeltine, on the "Early Development of the Mahoning Valley Region," and on "General Mining Engineering Subjects;" one by Thomas Middleton, on "Mining Legislation;" and one by Andrew Roy, the inspector of mines for the State, on the "Causes of Horsebacks in Mines." All the papers were discussed at length. The paper by Prof. Orton was one of surpassing interest, and elicited approving criticism. The other papers were by practical engineers, and were replete with valuable practical truth to the profession. They will each be published in the official organ of the Institute—the *Trade Review*, of Cleveland.

At Longstreth's mines, on Monday Creek, the Lechner machines were used for mining. These mines were visited by a number of engineers from the northern and southern portions of the coal field on Friday evening, but too late to see the machines at work. The Harrison and Lechner machines being used in adjoining mines in the valley, each machine has its special advocates, but the engineers seemed more favorably impressed with the Lechner than the Harrison. At the same time the visitors admitted that in many coal regions favorably located as to conditions these "iron miners" must be considered a success. Their long use in the mines of the valley is a proof of their adaptability to this coal region, and they seem to be gradully but surely finding their way to all the great coal producing regions of the United States. The Harrison machine is higher than the Lechner, the former weighing 800 pounds the latter 1,500 pounds. The Lechner cutter is a horizontal bar with inserted knives, which cut a groove 4 in. in height 5 ft. in depth and 8 ft. in width in the bottom of the coal. The Harrison cutter is a circular piston, on the end of which a pick point is inserted; the stroke is about 9 in. in length and is delivered very much as a miner strikes with his pick.

The mines of the valley visited by the engineers were opened on the great vein coal, and were 6 to 7 ft. in height, all level, free, dry, comfortable, well-ventilated and well-managed.

At Straitsville and Shawnee, a few miles distant, the vein is 9 and 10 ft. high—even rising to 11 and 12 ft. occasionally. It is not generally known that this additional height is caused by the union of two beds of coal, but such is the fact. The engineers gave this subject especial attention end satisfied themselves fully as to the facts by ocular demonstration—the best of proof

After the close of the evening meeting on Friday, which was held mainly for the purpose of arranging a programme for the next meeting, the session closed, to meet at the call of the president in Youngstown.

The general officers of the Institute are: President, Andrew Roy, Columbus; Vice-President, Fred Howell, Zanesville; ;Secretary, R. S. Paul, Akron ;,Treasurer, John Ackley, Athens.

I did not get the names of the Executive Board. This institute has been but recently organized, the Nelsonville meeting being the first one held in the coal regions of the State. The Association meets three times in each year. The first meeting is held in Columbus in January, and the two other meetings are held in the coal regions at the call of the President. The Institute numbers 35 to 38 members, all mainly practical men in practice as engineers, colliery superintendents, civil and mechanical engineers, and graduates of the School of Mines.

All the members were highly delighted with the meeting and the visit to the mines, and are under obligation to Mr. Thomas Black, the Superintendent of the Akron Iron Co.'s mines, and to Mr. John R. Buchtel, General Manager of the Akron Iron Co., for kindness and courtesies shown them.

VISITING ENGINEER.

NELSONVILLE, O., May 13, 1882.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES. M. AM. SOC. C. E.

Continued from page 143.

CCCVII.—LEOMINSTER.

Leominster, Massachusetts, in lat. 42° 32 N., long. 71° 45 W., on the Nashua River and Monoosnock Brook, is on undulating ground, the eastern portion being a sandy plain and the western hilly. Settled in 1725, it was incorporated in 1740. Water-works were built by the town in 1873, after the plans of Phinchas Ball, C. E., taking the supply from Morse Brook and Haynes Brook, which receive the drainage of about 2 square miles. An impounding reservoir on Haynes Brook is formed by an earth dam, with stone masonry heart wall, 15 ft. high and 698 ft. long. Its capacity is 150,000,000 gallons. The water of Morse Brook is impounded in a reservoir holding 10,000,000 gallons and covering 20 acres. This was constructed before its purchase by the town. The distributing reservoir is formed on the stream by an earth dam, with stone masonry heart wall, 23 ft. high and 804 ft. long. Two 14-in. cast-iron pipes convey the water through the dam from a gate chamber built inside the reservoir. A waste-way of stone masonry, 25 ft. wide, is provided. The earth underneath this was "a clayey quicksand," end caused some trouble and much apprehension for some years. In 1879 the waste-way was rebuilt on good gravel.

Distribution is by cement-lined wrought-iron pipe of from 12 to 2-in. diameter. On March 1, 1882, there were in use 18.16 miles of pipe, with 118 fire hydrants, 111 gates and 652 taps. One meter is in use. The town contributes annually $50 for each of 112 public fire hydrants. Service pipes are of cement-lined wrought iron.

The population in 1880 was 6,000. The consumption is not known.

On Sept. 8, 1881, a stroke of lightning destroyed 675 ft. of main pipe, and in January, 1882, 78 ft. of cast-iron pipe laid across the Nashua River froze and burst.

The cost of the works to March 1, 1882, was:

For construction	$165,578.41
For service pipes	5,307.25
Maintenance	95,578.37
	$266,552.03

The receipts had been $108,007.06; the bonded debt is $160,000, at 7 and 6 per cent. interest; the expenses of maintenance for the year ending March 1, 1882, were $2,688.59, and the receipts from water rates $15,874.79. The works are managed by a board of three commissioners, one being elected annually. The Superintendent is chosen annually by the board. C. H. Merriam is Chairman of the board, and Joseph G. Tenney the Treasurer and Superintendent.

CCCVIII.—BELLOWS FALLS.

Bellows Falls, Vermont, in lat. 43° 8' N., long. 72° 26' W., is on the Connecticut River, at a point where there is a considerable fall in the stream, affording valuable water-power. Mt. Kilburn is on the east side of the river and a range of hills on the west.

It was incorporated as a village in 1833.

Water-works were built by the village in 1848, taking the supply from Minard's Pond, a natural basin of 75 acres area, fed by springs, and with no stream entering or flowing from it. It is 300 ft. above the village, to which the water is distributed from the pond by cast-iron pipes of 8, 6, 4 and 2-in. diameter. There are 6 miles in use, with 40 fire hydrants, 15 gates, 500 taps end 12 meters. The village pays $1,000 per year towards the support of the works. Lead and iron service pipe are used.

The population in 1880 was 2,228. The daily consumption is not known.

The works cost $60,000. There is a bonded debt of $47,700 at 6 and 5 per cent. interest.

The expenses in 1880 were $1,060.78 and the receipts $4,125.16.

The works are managed by three commissioners. F. H. Brown is the Superintendent.

CCCIX.—DANSVILLE.

Dansville, New York, in lat. 42° 33' N., long. 77° 47' W., is in a valley with hills on three sides, on Mill Creek, which has a water-shed of about 10 square miles. Settled about 1795, it was incorporated as a village in 1845.

Water-works were built by the village in 1874 for fire protection only, after plans of D. M. Greene, C. E.

The water is taken from a well in a mill dam on Mill Creek, about 190 ft. above the village, and conducted 2 miles in a 10-in. pipe of wooden staves banded with iron and coated with asphalt. The branches are of 6 and 4-in. pipe. Four miles in all are in use, with 40 fire hydrants and 9 gates. When the works were first tested, 7 hydrants were opened, and on this being simultaneously closed, a number of breaks occurred in the pipes. Several breaks have also occurred from careless workmanship in the grading of the branches and the laying of the pipes, but they are now reported in good condition. It is contemplated to build a reservoir shortly.

The works have cost $24,800. The bonded debt is now $10,000, at 7 per cent. interest.

No further financial statements are given.

J. H. Robbins is the Superintendent.

CCCX.—DOWNINGTOWN.

Downingtown, Pennsylvania, in lat. 40° 0' N. long. 75° 38' W., is in Chester Valley, a long, narrow valley extending through Chester County.

Water-works were built by a private company in 1874, taking the supply from mountain streams and conducting it by gravity to the borough and distributing it through 7 miles of 6, 4 and 3-in. cast-iron pipe, with 1 fire hydrant and 200 taps.

The population in 1880 was 1,554. The capital stock of the company is $50,000. The works have cost $54,000. The bonded debt is $4,000, at 7 per cent. interest. No other data are furnished.

James B. Sirves is President of the company.

[TO BE CONTINUED.]

ACKNOWLEDGMENTS.—The receipt of statistics as follows is acknowledged with thanks:

From F. H. Brown, Superintendent, statistics and water rates of the water-works of Bellows

Falls, Vt. From J. W. Robbins, Superintendent, statistics of the water-works of Dansville, N. Y. From C. H. Merriam, Chairman Water Board, statistics and water rates and set of reports of the water-works of Leominster, Mass.

CORRECTION.—April 15, 1882, p. 123. *Moline.* The daily consumption was given in cubic feet by mistake. In 1880 it was 90,000 gallons and is now 188,000 gallons.

CORRESPONDENCE.

STRAW PLANKS.

BALTIMORE, May 13, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: A friend of mine, writing from Africa, asks where he can learn something about planks made of straw, of which he has seen notices. I have made inquiries in various quarters, but can as yet learn nothing definite on the subject. I will be much obliged if, from your commanding position at the center of engineering news, you will enlightan me.

Respectfully and truly, W. P. C.

[We hope some one of our readers will furnish the above information as soon as possible.—EDITOR ENGINEERING NEWS].

RICHMOND, Va., May 17.

TIMBER ROOFS.

EDITOR ENGINEERING NEWS:

Will some of your readers give the most approved joint for a principal and the tie beam in timber roofs of large span timber, not well-seasoned pine? The tie beam is not to project outside of the wall which supports it.

I do not find any very good arrangement in the books on carpentry, of which I possess, I believe, the usual variety. SUBSCRIBER.

TABLE FOR ANGLES IN PLATE GIRDERS.

NEW YORK, May 13, 1882.

EDITOR ENGINEERING NEWS:

Can any of the readers of your esteemed paper furnish the undersigned with a table for computing rapidly the net and gross sections of angles used in proportioning plate girders, riveted structures, etc.? J. D. F., C. E.

LOCK-GATE IMPROVEMENT.

NEW YORK, May 18, 1882.

EDITOR ENGINEERING NEWS:

Mr. Wierman, Chief Engineer of Pennsylvania Canal Company, applies to us for information as to "Samuel T. Seely's gate improvement" for canal gates. He has a number in use (put in years ago) and wishes to order more. They were formerly made by Peake & McCarthy, Advance Iron Works, of this city. Can you procure us any information on the subject?

GEO. F. BLAKE MANUFACTURING CO.

[We have no doubt some of our readers can give the desired information. We hope they will do so at earliest convenience.—ED. ENG. NEWS.]

NYE STEAM VACUUM PUMP.

76 BANK STREET, NORFOLK, Va.
May 8, 1882.

EDITOR ENGINEERING NEWS:

In the last number of ENGINEERING NEWS, page 3, I observe a note on the sinking of a caisson for the "Lake Water-works," by Messrs. C. J. & W. T. Bates, using a "Nye steam vacuum pump" for removing sand.

I have for some time been looking for such a pump to remove sand and water together in the sewerage works of this city. Can you inform me further about this pump, and where I can get it.

Tha note in ENGINEERING NEWS does not state at what city or lake the "Lake Water-works" are, or I would not have subjected you to the inconvenience of answering my inquiry, but would have written to the water-works company.

Your courtesy will oblige

WM. HENRY BALDWIN,
Asst. Engineer Norfolk Sewerage Dept.

[The Messrs. Bates, whose address is 149 La Salle street, Chicago, probably referred to the town of Lake, Cook County, Ill. The Superintendent of Water-works of that town is Jacob T. Foster, C. E., and his address is "Stock Yards," Chicago, Ill.—ED. ENG. NEWS.]

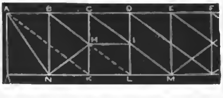
REPLACING CHORD BARS.

COUNCIL BLUFFS, May 15, 1882.

EDITOR ENGINEERING NEWS:

Possibly my statement in the NEWS of May 5 of the problem for replacing chord bars was not as plain as it should have been.

The tie bar *CM* is continuous and has no connection with any member except at each end.



The strain in *DI* must be transferred to the ties *HI* and *IE*, the tie *BHIE* passes under the feet of temporary posts along *CH* and *DI*.

Mr. Rudiger's solution is right assuming the post *DL* and tie *CM* to be connected at *I*, but it would be very difficult to make such connection.

Would be glad to hear from Mr. Rudiger again.

CHAS. F. LOWETH, Assistant Engineer.

RAILROADING ON THE PACIFIC SLOPE.

E. G. Tilton, of Yale, B. C., contractor, chief engineer and general superintendent of the Pacific end of the Canadian Pacific R., in an interview with an *Oregonian* reporter, gave the following information concerning that enterprise: Last February a contract for building 85 miles from Emory Point, 5 miles below Yale, to Port Moody, the western terminus, at the head of Burrard inlet, was let to Andrew Onderdonk and associates, and the work of clearing and bridging is already under way. Grading will be commenced about the 25th of this month. Arrangements have been made for the importation of 8,000 Chinese, to arrive within 60 days. Two vessels, with 1,200 coolies, arrived last month, and the men are now at work. Five thousand men will be put on the line between Emory and Port Moody, and a like number on the Frazer River. The work thus far on the Frazer has resulted in the completion of 28 miles of track, under a contract secured in 1880, northeast from Emory. Upon these 28 miles 1,000 men have been at work for 18 months, and the grade from the 60th to the 90th mile is nearly completed. The work from Emory to Thompson's River, a distance of 60 miles, is probably the most difficult and expensive on the North American continent. Frazer River is bordered with steep, rugged mountains of solid granite, from 5,000 to 8,000 ft. high. In the first 17 miles there are 18 tunnels—four in one mile and six in another. In 2 miles on the division above Emory there are no less than 600 trestles and bridges, and in the last 85 miles more than 100 embankments, which at the foundation level are 17 ft. wide, and the cuts 22 ft. The tunnels are 22 ft. wide and 21 ft. high. None other than 58-pound steel rails are used. In the upper section of the work there are 10,000,000 cubic yards of earth, and excavation of 3,000,000 cubic yards of rock, exclusive of the tunnel, and 2,000,000 cubic yards of rock and cemented gravel. Between 30,000,000 and 40,000,000 ft. of timber, board measure, are required for the structures. Over the entire contracts the rock is of the hardest compact granite, in which often occur wide and extremely rich quartz veins. For miles the road is literally hewn out of the side of the cliffs. The approaches to many of the tunnels are galleries. At the eastern approach is tunnel No 7, for over 100 ft., the bluff is galleried, and overhangs the roadway 24 ft. in width, or 2 ft. outside the road-bed, below which is an almost perpendicular precipice of 200 ft. The first tunnel is at the north end of Yale, and the first four happen within a mile and a half of the town. It required eighteen months to build the first 2 miles, working in the tunnel night and day. From one point six tunnels are visible at a glance. The grades and curves are moderate, the heaviest grade being 50 ft. to the mile. The line follows the west bank of Frazer River to a point 8 miles below Lytton, where Thompson's River empties into the Frazer. There the latter river will be crossed by an iron and steel bridge, to cost $300,000. The line will then follow the south bank of Thompson's River to Kamloops Lake. The contractors expect to have completed by the end of this year 120 miles of grade, and have 50 miles of track in operation. The first 2 miles north from Emory cost a trifle over $200,000 per mile, and the 11 miles from the eighteenth to the twenty-ninth, cost $175,000 per mile. The average cost per mile of the upper division along the Frazer and Thompson's rivers will be over $75,000 per mile. This does not include the cost of rails and fastenings, which are furnished by the government. The cost of the 212 miles from Port Moody to Kamloops Lake will be, exclusive of rails, $12,000,000. The company have at Yale erected nitro-glycerine and powder works, with a capacity of 11,000 pounds per day, and car and machine shops, and all the supply departments. A steamer is under construction, and will be launched in a few days, for the navigation of the upper Frazer between Boston Bar and the mouth of Thompson's River. The boat is intended for the transportation of supplies, and will be the first to ascend above Boston Bar.

STREET PAVING SPECIFICATIONS.

The grade shall be as follows, to-wit: Beginning on the south side of New York street with zero and numbering consecutively to the north curb line of St. Clair street, between station zero and 5 plus 38.5, and ascending grade two feet to the thousand feet; between station 5 plus 38.5 and 15, a descending grade of one and one-half feet to tha thousand feet; between station 15 and 16, level; between station 16 and 24 plus 73 (being the north curb line of St. Clair street), an ascending grade of one foot and six-tenths to the one thousand feet.

A station is one hundred feet. The cedar blocks shall be laid on the grade herein set out; the blocks shall be of good, sound, live timber, free from bark, loose or rotten knots, or other defects, and shall be six inches in length, and from four to eight inches in diameter, ends to be sawed at right angle to the axis of the blocks; blocks must be placed on end in a close, compact manner, care being taken to so arrange the larger and smaller blocks together that the interstices shall be left as small as possible, and that no square holes will be found. All blocks adjoining the curb to be split and the flat side placed next the curb, so as to make tight and even joints, each block to rest squarely upon the base without binding. Whenever any blocks are found loose, or with knots or bark on them, or any defective blocks, all the pavement afterwards laid shall be taken up and properly relaid at the expense of the contractor. After the blocks are properly laid they shall be rammed with a heavy rammer nine inches in diameter and flat at the base, and all the blocks brought to a smooth, level surface. The spaces between the blocks to be filled with clean, dry, screened river gravel, of a size from one-quarter of an inch to three-quarters of an inch in diameter, the proportion of said gravel to be such as to completely fill the interstices. The gravel in said interstices shall be rammed with steel-pointed bars of such shape and size as to enter all interstices freely. After the gravel shall be thus pounded down from one and a half to two inches, the spaces shall be again filled with the same kind of gravel and again rammed as before. Hot composition, not less than one and a fourth gallons per square yard, shall then be poured over tha entire surface of the blocks, composition to be equal to Barrett & Arnold's best paving composition, distilled at four hundred (400°) degrees Fahrenheit, and used sufficiently hot to give it proper body; after which clean, dry, screened river gravel, about the size of peas, shall be spread over the street in sufficient quantity, so that, when swept, all interstices between the blocks will be thoroughly filled. After this latter coat of gravel is well broomed in, the whole surface of the street shall be again covered with hot composition, not less than three-quarters of a gallon per square yard, and immediately covered with roofing gravel screened from that used to fill the spaces between the blocks; said covering to be not less than one-half inch in depth.

All the cross-walks shall be made level with the center of the street, and the sides to a level with the curb; the intersections of all cross streets and alleys to be paved with cedar blocks to the regular width of the roadway, and the wings of all said intersections to be graded and bowldered according to stakes of the City Civil Engineer. The bowlders shall be placed on enough bank sand to make the surface of bowlders fifteen inches above the sub-grade; all bowlders to be set on end as firmly and as compactly together as it is possible to set them, and to range in size from four to six inches in longest diameter.

Double stone crossings to be put down with the bowldering, and to be raised from two to three inches above the bowlders; stone to be of tha best quality of limestone, not less than four feet in length, fifteen inches wide and six inches thick, and to be placed in parallel rows eighteen inches apart. All of said work shall be done according to plans and specifications on file in the office of the City Civil Engineer, Indianapolis.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

GEO. H. FROST..............PROPRIETOR.
Tribune Building. New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR. .... ASSOCIATE EDITOR.

SATURDAY, MAY 20, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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WE wish to secure as full a record as possible of all new contract lettings; will readers of this journal please to assist us as far as they are able. Will they also send us the results of such lettings as they may have access to; the comparisonof bids is very valuable to contractors in making up future bids on work.

WE call the attention of city engineers, railway engineers, and all other parties having control of contract lettings, to the superior advantages of advertising their proposals in this journal. We claim—without fear of refutation—that it is the special organ, most widely read, of engineers and contractors, in this country, and it is also the *cheapest* medium for advertising proposals. The rate is *ten cents per line*, each insertion, and for all classes of engineering work it is superior even to the most widely circulated dailies, as it goes direct to the leading contractors of the country, men who are ready for any work, from building a culvert to a transcontinental railway. Try advertising as we advise and test the results.

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OUR NEW NAME.

Contracting intelligence has constituted so large and important a department of this journal that we hardly consider an explanation of our enlarged title necessary. It is done for the purpose of more fully advertising the real scope of our publication, and thus enlisting as subscribers and advertisers a very large class who look for such a journal as ours, but do not recognize its applicability to their wants by its hitherto appellation. Engineering and contracting go hand-in-hand the world over, each depending very much on the other for success, and it is eminently fitting that the same journal should cater to the business wants of both. We recognize more fully, as we grow older, that engineers and contractors are very much like other men, in that they are always ready to hear of some "new thing"—and he who can tell them a great many new things *every week* cannot fail to add very materially to the sum to al of their individual satisfaction. It will not *pay* for any one journal to undertake to publish all the engineering and contracting intelligence of this continent and, at the same time, undertake to give its readers lengthy papers on engineering, which now more than occupy the columns of several good-sized journals. So it is that we prefer to deal with the curious, news-seeking, "sordid" side of our constituency, and if we can assist them in securing profitable situations or "fat" contracts, we are very willing to let our esteemed contemporary in Murray street, or our Western brother, delight their readers with the mysteries of calculus and other recreations of the intellectually inclined. We propose to give the *news* as fully as we can, and at the same time contribute as much as possible to tha intellectual "hankerings" of our patrons. We are very much gratified with our present list of readers, but we confidently expect to see the list very much increased during the present season. The plethoric condition of the National Treasury ought to make glad the hearts of untold numbers of contractors, however much the individual taxpayer may deplore the necessity for "improving" all the mountain streams of the continent, or erecting first-class post-offices in numerous Podunks, which our benevolent law-makers are so diligently log-rolling about at the National Capital, and it is to facilitate the research of numerous seekers after profitable contracts that we are preparing for the summer campaign that will in a few days be at its best. The government proposes to spend on its rivers and harbors nearly twenty millions of dollars, and probably as much more on buildings; how much on all manner of supplies, we do not know. Then there are innumerable private and municipal contracts always being advertised. As far as diligence and industry can obtain knowledge of these lettings, we propose to have them each week. It is a laborious task; but if we are well paid for it, as we expect to be, we will not complain, and the convenience and economy to our patrons in finding this class of news easily and cheaply is only too apparent. They may well congratulate themselves that it is our head and not theirs that does the aching over the several hundred daily and weekly newspapers that must be examined each week for the news of a continent, and we feel assured that they will look upon the subscription price of this journal as a very satisfactory investment.

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BUILDING, MATERIAL AND WAGES.

The total estimated value of the structures for which the Bureau of Buildings of this city granted permits during the first three months of the present year is $10,982,600. This aggregate represents 924 new structures, whose cost, as calculated by the architects and builders, will be $9,617,600, and alterations to existing buildings to cost $1,153,000. For the same period the city of Brooklyn granted permits for 383 buildings, having an estimated cost of $1,458,000, with alterations to existing buildings to cost $183,000. These records indicate a continuance of the unexampled activity in building that marked the year 1881, which was unprecedented in regard to the money value of the operations, and was an increase in the number of buildings over that of any previous year except 1871.

These causes produced a great demand for all building materials during last January, February and March, and as real estate seemed to be booming this demand was considered healthy. Taking advantage of this the prices advanced; skilled labor reached figures it had not touched for years; common labor was remunerated at far more than its real value. Brick, the most essential item in estimating for contracts in this city, brought high prices, and the market seemed to be firm and steady.

Proving again the law of demand and supply, the high prices induced large shipments, and all who had bricks profited by the rise and threw them on the market. An unwonted activity was induced at all the manufacturing points along the North River—whence New York obtains most of its common bricks—and as a natural consequence there was soon a supply far in excess of the demand. The facts that the market was overstocked and that most of the heavy contracts had been let, produced a reduction, during the latter part of last week in the price of North River Hards of about $3 per thousand, or from $11@$11.25 to $8@$8.25. These figures now seem steady, and although low in comparison to those recently prevailing, yield a fair profit to both manufacturer and dealer. The fall has affected nothing else in the building line, and prices remain firm.

These prices, if continued, as they in all probability will be, considering the present stock and the season, may produce an increased amount of building during the summer and fall. When low prices are ruling and money is plenty, as at the present time, builders and owners take advantage of the state of affairs, and do as much business in as short a time as possible. Moreover, the prosperous condition of the country makes improved real estate of any kind valuable beyond what it is intrinsically.

But before operations assume extensive proportions the question of wages will be considered, and if the rates are excessive nothing of any magnitude will be inaugurated, even though the prices of building materials fall to the lowest figures. It is in cases such as this when the artizan and laborer practically control the use of capital, and it depends upon them whether that capital will remain idle or be productive. Masons in this city are now getting from $4.00 to $4.50 and hod carriers from $2.00 to $2.50. Should operations cease for a short time these rates would be reduced, as the law of demand and supply is as applicable in this instance to men as it was previously to bricks, trade unions to the contrary notwithstanding. A combination of low prices for bricks and low wages for men would be apt to induce extensive building movements during the latter part of summer and fall.

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THE AMERICAN IRON AND STEEL TRADE.

There is a sluggishness in the demand for railroad material which indicates an uncertainty among railroad managers as to what course to pursue. A few months ago mills were overwhelmed with orders and inquiries, some of which had reference to deliveries twelve months ahead. At present orders are slim and irregular. Prices have weakened until quotations cannot be given with certainty. The lowest sale for three years was made at a Pennsylvania mill a few days ago at $47.50. Rail makers quote prices at $50 to $58. Capacity is being extended in an increase of six converters from thirty-one to thirty-seven, which will afford facilities for almost any demand which may be expected for years to come. The future of railway construction depends much on the magnitude of crops and the volume of export trade. The export trade depends, of course, on the relative prices of American and European competing products. Railroad and iron and steel manufacturing interests are studying the economic problems of the near future with deeper interest than statesmen are supposed to give to such subjects. A vast volume of capital awaits investment in railroad schemes. It is not out of the way to say that a sharp renewal in railroad construction will follow abundant crops and a strong export trade. For the present conservative counsels will prevail until a more encouraging condition of trade attracts heavier investments. Imports of iron and steel continue large, though no serious effects are shown on American production or market quotations. The foreign markets are quite active, though prices are weakening according to latest cables.

The American iron trade is only holding its own between an advancing tendency in the cost of labor and a declining demand. New enterprises are not being hastened forward with the same vigor which was exhibited last fall. Even at minimum limits, the consumptive demand is very fair. The fact that with consumption restricted to within the narrowest limits possible prices do not weaken more than they do is a favorable feature of the iron trade. Yet the productive capacity is expanding and the increase in output is bound to tell on prices sooner or later. Railroads are buying less than usual, the labor forces in yards, shops and tracks are being curtailed from 14 to 25 per cent. and expenditures generally restricted in order to favor dividends, which have shown up less favorably of late. Yet nearly all mills are fully engaged on double time; one here and there is dropping off. Wages disputes are threatening a restriction of production. Demands have been made for higher wages, and there are indications that tha demand will be extended to other sections.

The merchant iron manufacturers have reduced the price of finished iron from 2.8c. in Eastern centres to 2.6c.; in Western Pennsylvania to 2¼@2.4c. Competition is at work. Bridge works are generally crowded with orders through the summer. Structural mills have engagements for entire capacity for a like period. Plate iron of all kinds is in sufficiently active demand to keep all mills running on full time; but buyers are not anticipating wants, and hence prices are more in their favor. Tank is three cents in small lots and one to two-tenths less in large lots. Bridge plate, 3@3¼c. Shapes 3 @4c. Deliveries can be made more promptly than a few months ago in all except shapes and steel rails. Crude iron is steady and firm according to market reporters. Tha cost prevents much of a concession. Production is equal to demand, but very little if any more than equal. Bessemer is arriving in occasional lots at $23@$24. Domestic supply is increasing, but the high prices of lake ores prevent lower rates than now rule.

PERSONAL.

R. H. COUSINS is Chief Engineer of the Sabine & East Texas Railroad.

C. F. STEPHENS is Chief Engineer of the Texas & St. Louis Railroad.

J. H. THOMPSON is Supt. and Engineer of the Wilmington & Northern Railroad.

MR. JOSEPH O. OSGOOD has been appointed Chief Engineer of the California Southern Railroad.

GEORGE JENNINGS, of Lambeth, England, well known in sanitary matters, died recently from the effects of a carriage accident.

OWEN MERIWEATHER, C. E., of Memphis, Tenn., is engineer in charge of constructions of the Natchez, Jackson & Columbus Railroad.

THE resignation of Second Lieutenant Edward O. Brown, of corps of engineers, has been accepted by the President, to take affect tha 1st of July.

MR. WILLIAM MCBRIDE, a Water Commissioner and a prominent contractor of Long Island City, N. Y., has absconded, leaving debts, it is alleged, as far as ascertained at present, amounting to $15,000.

MR. S. L. MERCHANT, dealer in Portland, Roman and Keene's cements, has removed his headquarters from No. 41 Broadway to No. 5 Bowling Green, this city.

THE general offices of the North River Construction Company and the New York, West Shore & Buffalo Railway Company have been removed to 15 Broad street, Mills Building, New York City.

JAMES G. KANEY is Chief Engineer, and Prof. **CHAS. S. GREENE**, of Ann Arbor, is Consulting Engineer of the Wheeling and Lake Erie R. R. Bridge Co.; office, room 34 Hartford Block, Toledo, O.

The firm of **DARRAGH & HAVILAND**, of Columbus, O., contractors for the Minneapolis viaduct, has been dissolved by E. Darragh buying his partner's interest. Mr. Darragh continues the contract on the viaduct. His address is 47 Sixth avenue, S. E., Minneapolis, Minn.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the regular meeting on May 3 the following were chosen members: Wm. G. Curtis, San Francisco; Edward C. Kinney, Des Moines, Ia.; Gustav Lindenthal, Pittsburgh, Pa.; Thomas C. McCollom, U. S. N., New London, Conn.; David Reeves (transferred), Philadelphia.

C. D. W. YOUNG, auditor of the Chicago, St. Paul & Omaha Railroad and one of the newly elected directors of the Minneapolis and St. Louis railroad, **STEWART MOORE**, chief clerk in the freight office of the Northern Pacific Railroad, both of St. Paul, and **C. C. GOSSACK**, of Shakopee, were drowned in White Bear Lake, Minn. last week.

MR. ALBERT FINK has bean tended the presidency of tha Louisville & Nashville Railroad Company. The offer was made unconditionally, and is now being considered unconditionally. The presidency of the company has been offered to no one besides Mr. Fink. The company desires to retain him because he was connected with the road from its inception as civil engineer, and he worked his way up to vice-president. Mr. Fink has as yet made no answer.

SIMON FRAZIER fought in the war of 1812, drifted ashore on a single timber from his raft, which the St. Lawrence rapids had knocked to pieces, was blown fifteen feet into the air by tha premature discharge of a blast, assisted in a boiler explosion on the Hudson, was brought home half dead from three other accidents, of which the particulars have not been preserved, twice recovered from illness after his doctors had given him up, and finally died in peace at Troy, N. Y., Tuesday evening the 9th, in the Home for tha Aged, at the age of 105 years.

ENGINEER CORPS MEXICAN CENTRAL.—We have received from reliable sources the following addition to the Engineering Staff published April 29: S. C. Slade, Material Agent; F. M. Bisbie, Superintendent Track; Wm. Humphrey, Superintendent Bridges and Buildings; J. H. Laudon, Master Mechanic; J. W. Webster, Fuel Agent. Ex-Governor G. T. Anthony, of Kansas, is tha General Superintendent. George H. Anthony is the Acting Superintendent of Transportation and Telegraph. Señor Don Bonito Leon Acosta, of the City of Mexico, is "Inspector del Gobierno," or Government Engineer.

MR. H. H. WARNER, of Rochester, offers the following astronomical prizes for the present year: Two hundred dollars in gold for each discovery of a new comet made (the discovery, not the comet) in the United States, Canada, Great Britain or Ireland; $200 for any meteoric stone found in any of the above countries during 1882, which Professor Henry A. Ward, of Rochester, N. Y., Principal Dawson, of Montreal, Canada, and J. Lawrence Smith, of Louisville, Ky., shall unanimously decide contains fossil remains of animal or vegetable life, thus proving the inhabitability of other planets; tha sum of $50 for a specimen of any meteoric stone (whether it contains organic remains or not) seen to fall in the United States during 1882.

A RECENT APPOINTMENT. — U. S. COUNSUL AND COMMERCIAL AGENT, MORRISBURG, Canada May 2, 1882.—i was There last sundy and Left mundy to Return. i Can not Be absent but a Short time At present. Until i Have my Assistant and deputys Properly arranged. i should Have Been pleased To have Met you on Return i find yur kind Letters and Paper Sent With Thanks. Please keep On sending me the press its Complements are Murthful My Office Is one Of the Highest In the consul service of The U. S. and Entirely satisfactory how pleased i will Be to Receive you here go sailing on the river st. lawrence and Haul In the Fish by the Bushel Give my Regards to the press But especially to Francis and the Times and believe Me Evers Yor Friend A. B. ELLIOTT, late editor of the *Lansing* (*N. Y.*) *Gazette*.

ARTHUR HAVILAND, C. E., and Sandford Horton, C. E., Assistant Engineers Tehuantepec Railroad, returned on Thursday morning by the steamer City of Washington. Mr. Haviland went to Tehuantepec two and a half years ago. Since then 106 kilometers (65 miles) have been located. The estimated distance across the isthmus is about 150 miles. *No continuous preliminary line has been surveyed.* There are now two parties engaged in location surveys and two construction camps, the further of which is 40 miles from tha gulf. There are on hand iron and ties for one-half proposed line; also, three locomotives and fifty flat and box cars. Laborers are exclusively natives, and are paid $1 to $1.25 per day, being about three times as much as is paid to the same class of laborers on the Central and National roads. The mahogany cutting trade draws to it all the labor of the country; henca the high prices. There is absolutely no call for engineers; carpenters and machinists are in demand; $4 per day to carpenters. The country is decidedly *tierra caliente*, and very wet, a slight summer showar rendering the roads almost impassable. The rainy season is from June to December inclusive; the rest of the year, especially April and May, is hot and dry. Mr. A. G. Bradstreet is at present acting Chief Engineer, Mr. Martin Van Broecklin, the late Chief (formerly of the N. Y. Elevated Railroad) having resigned last November.

MAJ. GARRETT J. LYDECKER, the Engineer Commissioner of the District of Columbia, succeeding the late Major Twining, is a native of New Jersey, and was selected for appointment to a military cadetship by competitive examination of pupils from the free schools of New York. He was at West Point from September, 1860, to June 18, 1864, when he was graduated and promoted to first lieutenant, corps of engineers. During the rebellion he served at the siege of Petersburg in the Army of the Potomac, being in command of a company of the engineer battalion. He was brevetted captain April 2, 1865, for gallant and meritorious services at that siege; also, as assistant engineer in making surveys at the theatre of military operations before Petersburg from April 18 to June 15, 1865 and while acting as assistant to the board of engineers for the melioration of the fortifications in tha vicinity of New York, he was promoted to be captain. He served as an assistant engineer on Fort Wayne, Michigan, and harbor improvemants on lakes Erie and Huron from April, 1867, to November, 1868, and on the works in charge of Major Prime from November, 1868, to April, 1869; as superintendent engineer of the defenses of New Orleans, the survey of Galveston Harbor, Texas, the 8th lighthouse district, west of Pearl River, from April to July 1869; he served as assistant professor of engineering at the West Point military academy from August 28, 1869, to February 15, 1871, and as principal assistant professor until August 15, 1872; as chief engineer on the staff of the commanding general of the division of the Pacific from September 8, 1872, to February 5, 1874; as assistant engineer on the works in charge of Major Housten, from February 24, 1875, to May 3, 1877, and as chief engineer of the division of the Missouri until July 16, 1878, performing the duties of superintending engineer of improvements of the harbor of Michigan City, of the new Buffalo Harbor, of the Chicago and Calumet harbors, and of the Illinois River. He was a mamber of the board of officers to examine candidates for the position of second lieutenant in the the army in 1873, and was also a member of the board of engineers on the improvement of tha Chicago and Michigan City harbors in 1878. He was stationed at Chicago continuously from January 1, 1878, as chief engineer officer at the headquarters of the military division of the Missouri. He was detached from duty as chief engineer officer July 12, 1878, and since that date has been in charge of improvements of harbors, particularly the Chicago harbor. He was promoted to be Major March 31, 1880. He possesses fine executive ability, is energetic, of sterling integrity of character, a thorough engineer, and stood among the first in his class at West Point. His detail to Washington is regarded with much favor by his former classmates, who speak in the highest terms of praise of him as an officer and a gentleman.

OBITUARY.

Brevet Major-General John Gross Barnard, Corps of Engineers, U. S. A., died in Detroit on the 14th. He had been an invalid for some time. His remains were taken to his late home in Sheffield, Mass.

General Barnard was a brother of President Barnard, of Columbia College, and was born at Sheffield, Mass., May 19, 1815. He was graduated at the military academy in 1833, and entered the corps of engineers as a Brevet Second Lieutenant. In 1835 he was sent South, and for several years he was stationed near Pensacola and New Orleans. He reached the rank of Captain in 1838. He served in the field during the Mexican war, and was rewarded with the rank of Brevet Major. In 1858 he was made a Major. In 1850 General Barnard served as a member of the Tehuantepec Survey Commission, assisting in the preparation of the first full report to the government concerning the Isthmus. In 1854 he was in charge of the construction of the fortifications at San Francisco, and in 1855-'56 he was superintendent of the military academy. From 1856 to 1861 he was in charge of the fortifications of New York harbor. He entered the field early in 1861, being present at the first battle of Bull Run as Chief Engineer on General McDowell's staff. In the same year he was made a Brigadier General of Volunteers. General Barnard directed the siege operations of the Army of the Potomac during the Peninsular campaign, and was afterward placed in charge of the defenses of Washington. In 1864-'65 he served with General Grant as Chief Engineer of the armies in the field, and was present at the surrender of General Lee. He was made a Brevet Colonel in the regular army in 1862, Lieutenant Colonel of Engineers in 1863, Brevet Major General of Volunteers in 1864, and Brevet Major General in the regular army and Colonel of Engineers in 1865. After the war General Barnard served as senior member of the Board of Engineers and as a member of the Lighthouse Board. He was placed on the retired list in January, 1881. General Barnard was a member and original corporator of the National Academy of Sciences, and was an active member of several other scientific societies. He received the degree of A. M. from the University of Alabama in 1838 and the degree of LL. D. from Yale College in 1864. General Barnard was a contributor to many standard publications and one of the associate editors of Johnson's Cyclopædia. Among his principal publications are the following: "The Phenomena of the Gyroscope Analytically Examined" (1858); "Notes on Seacoast Defense" (1861); "Reports of the Engineer and Artillery Operations of the Army of the Potomac" (1863), in conjunction with General W. F. Barry, Chief of Artillery; "Report on the Defenses of Washington (1871); "Report on the Fabrication of Iron for Defensive Purposes" (1871), made in conjunction with General H. G. Wright and Colonel P. S. Michie; "The North Sea Canal of Holland and Improvement of Navigation from Rotterdam to the Sea;" "Problems of Rotary Motion Presented by the Gyroscope, the Procession of the Equinoxes and the Pendulum" (1872). In 1864 General Barnard was nominated to be Brigadier General and Chief of Engineers, but the nomination was withdrawn at his own request.

Uniform Time.

In order to secure a uniform system of time-reckoning throughout the civilized world, Representative Flower, of New York, has introduced a joint resolution, in which the President of the United States is authorized to extend to the governments of all nations in diplomatic relations with our own an invitation to appoint delegates to meet those delegates representing the United States in Washington, at such time as the President may designate, for the purpose of fixing upon a meridian proper, to be employed as a common zero of longitude and standard of time-reckoning.

RAILROADING IN EGYPT.

One of the most magnificent of the late Khedive Ismail's projects, the Nubian & Soudan Railway, is now assuming something like a substantial form. The original idea seems only to have been to run a line from Assouan, below the First Cataract, to Wady Halfa, at the Second Cataract, thus saving the transport of merchandise either way from Nile boat to camel or vice versa, which at present takes place at both rapids. But already an extension 300 miles above Wady Halfa is contemplated by the scheme, and if that is carried out, in all probability the line will be lengthened some day to Khartoum, the capital of the Soudan, at the junction of the Blue and White Nile. "To some," says the London *Globe*, "this may seem a chimerical project, but there are few engineering difficulties in the way save at the Assouan end, which have been already pretty well overcome, and if it is ever carried to completion it cannot fail to affect most propitiously the future both of Nubia and the Soudan. It is to be a single line, of which at present seventy-five miles are finished, and as it leaves Assouan, it passes through a portion of the famous granite quarries out of which the Gizeh pyramids, near Cairo, and so many other Pharaonic works were made. The engineer, a Scotchman, has no European to assist him, and the ways of his Arab and Nubian laborers are anything but the ways of the English navvy. Nothing will induce them to use a wheelbarrow, and as they work in gangs, with a task-master standing over them, whip in hand, either supporting great masses on their backs or carrying away the débris in baskets, they forcibly recall to mind the habits and customs of the ancient Egyptians as depicted on the sculptures at Thebes and Karnak."—*N. Y. Tribune.*

[There is a variety of misinformation in the paragraph above. The "original idea" is hard to fix, but in '73-'78 the idea was to build the railroad from Wady Halfa to Khartoum, and surveys were made the whole way; studies and estimates for a bridge across the Nile far south of Wady Halfa were made, and in '77 the writer came into Wady Halfa from the south on a train which met him about 30 miles out.

The portion between Assouan and Wady Halfa was and is worked by steamers, and it was intended so to work it, as the navigation of that part of the river is fair. There are about 10 kilometers of railroad around the first cataract from Assouan to Philæ.

The pyramids of Gizeh are of limestone, which was quarried near Cairo, although considerable syenite was used in the passages and interior chambers.

The Khédive's consulting engineer, under whom the surveys and studies for the Soudan Railway were made, was Mr. John Fowler, of London, and the resident engineer who did most that was done until work was stopped was Mr. George Kilgour. Probably no work has been done since the spring of '78.]

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RECENT INVENTIONS.

APPARATUS FOR SUSTAINING TELEGRAPH WIRES IN CITIES.

This novel improvement has for its object the conducting of telegraphic wires, or wires for supplying the current to electric lights. A hollow girder containing wires for lighting and working purposes is sustained on a line of posts. On this girder are placed at intervals a series of supporting frames for telegraph and telephone wires. These frames contain each a series of vertically removable notched sections for securing the wires. A railing and platform are provided. A series of electric lamps may be placed upon top of the posts.

LEVER FOR STARTING AND MOVING CARS.

This improved car-moving lever is provided with a clutch on its end having rounded bearing surfaces, adapted to fit on the flange of the car-wheel, so that the clutch will slide freely thereon except when force is applied to the end of the lever.

NOVEL FIRE ESCAPE.

This escape consists of a band of flat webbing having slits formed therein for the insertion of the hands. It is fastened at the upper windows or cornice, and is of length sufficient to reach the street below.

UNDERGROUND CABLE-WAY.

In this improvement a conducting carriage travels within the tunnel on angle-iron ways supported by brackets consisting of double and single curved bars. The carriage is provided with rollers and a downwardly projecting arm, to which is secured a rope by which it is connected to a supplemental carriage. The first-named carriage has a pivoted latch which automatically engages and disengages with a socket in the grip. The supplemental carriage consists of a vertical body provided with a gravity latch to engage and disengage with the grip, and at its ends with V-shaped angle-irons and is adapted to travel in V-shaped angle-iron ways secured to yokes placed at suitable distances apart in the tunnel. This device is designed particularly for turning curves of endless cable-ways.

RAILROAD CHAIR.

The base-plate of this improved chair has a cheek for one side of the rail and an abutment serving as a fulcrum on the other side for a lever-cheek piece, which is strained in position by a wedge between it and the base-plate. The parts are kept in proper relation to each other by ribs and grooves.

RAILWAY RAIL.

The meeting ends of the rail in this improvement interlock by reason of acute angular-beveled projections and shoulders extending to the rail centers, at the said ends. The ends have also central-beveled, longitudinal, vertical faces.

FIRE-ESCAPE.

In this improvement, the crank-arm of the shaft which holds the weighted cable-ladder is held from turning by a notched button, which is connected to a controlling rope, which may be released from any story of the building. Projections on the weighted cable ladder strike alarm bells as the ladder descends.

NOVEL TELEPHONE ALARM.

In this important improvement the arrangement is as follows: At each subscriber's station a branch or ground circuit, normally disconnected from the main line, contains a magnet, which controls a mechanically operated bell. At the several subscribers' stations, *seriatim*, this branch is connected with the main line by a clock-work, which moves synchronously with a transmitting clock at the central office. The transmitter, at starting, sends an impulse to line, starting all the clock-trains, and then at any desired point in its revolution it sends a second impulse, thereby calling up that station, and at that station only, which at that time is connected with main line.

ELEVATED RAILWAY.

This improvement has trussed towers, support continuous cables passing over chairs on said columns with anti-friction rollers, the roadway being suspended from the cables by guys, the supporting towers being braced, and the approaches at corners constituting solid roadways.

F. B. Brock.

Washington, D. C.

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THE CHICAGO BRICK AND LUMBER MARKET.

The condition of the brick and lumber market just now excites a great deal of uneasiness, though for widely different reasons. There is practically a famine in the common brick trade at present. All the old stock is used up or in the hands of contractors, and new brick exists as yet only in the unmolded clay at the several yards. The strike of the brickmakers is still in full tide, though the manufacturers say, as they did a week ago, that the men will soon go to work at the manufacturers' prices, which are the same as were paid last year. The new brick thus far contracted for are to be had on a basis of about $8 per thousand. Some brick are being made just over the border in Indiana, but these, manufacturers say, cannot be laid down here for less than $11 per thousand. This scarcity is interfering seriously with building operations in this city, as the longer the strike lasts the more inclined are the manufacturers to increase their figures for future delivery. The general opinion among dealers is that one result of the strike, should it end to-day, would be to increase the price of brick to the general consumer 50 cents per thousand for the next three months.

It is daily becoming more apparent that the tension in lumber prices is too great, and that a giving way in many important grades must occur in the near future. The causes leading to this state of things are the extraordinary increase in the receipts since Jan. 1, as compared with last year. This increase, according to the report of the Secretary of the Lumberman's Exchange, was, on the 5th inst., 147,630,000 feet of lumber and 39,074,000 shingles. This gain has been due largely to the early opening of navigation, but a good part of it is attributable to the high prices which have stimulated the manufacturers. Had Muskegon, where strikes have prevailed for some time, contributed her usual quota, the increase at the present time over the receipts of last year would not have varied much from 200,000,000 feet. Sales on the cargo market are being made with more difficulty, and prices of everything outside of shingles and lath have a decidedly unstable floating.

Mention has already been made of the large quantities of lumber that were sold during the winter to arrive at prices above those ruling at the close of navigation last Fall. Several parties holding these contracts, not satisfied with the outlook, are selling the cargoes as they arrive at the Franklin street dock rather than take the risk of incurring loss by piling them in their yards. A movement is on foot among the trade looking to a revision of the yard price-list, the revision to be entirely on the side of reduction.

IRON AND METAL EXCHANGE.

The New York Iron and Metal Exchange Company was formally opened on the 16th at No. 69 Wall street, speech making and feasting continuing from noon until late in the afternoon. It is an incorporated company, and among its stockholders are the Thomas Iron Company, B. F. Judson, Naylor & Co., James R. Thompson & Co., the Burden Iron Company, Crocker Brothers, J. B. & J. M. Cornell, Port Henry Iron Ore Company, Cooper, Hewitt & Co., David Thomson & Co., National Tube Works Company, Manhattan Iron Works Company, William H. Wallace & Co., Catasauqua Manufacturing Company, Witherbees, Sherman & Co., Thomas J. Pope & Brother, Edward Bech & Co., the Joliet Steel Company, the Albany & Rensselaer Iron and Steel Company, George A. Evans, E. S. Wheeler & Co., Abraham S. Patterson, O. E. Schmidt & Co., James Williamson & Co., the Lackawanna Iron and Coal Company, and Phelps, Dodge & Co. The opening exercises yesterday were under the superintendence of the company's Board of Directors, consisting of James B. Brinsmade, of Edward Bech & Co.; Edwin F. Bedell, of Cooper, Hewitt & Co.; Frederick L. Lehmann, of Naylor & Co.; Thomas J. Pope, of Thomas J. Pope & Brother; Benjamin G. Clarke, of the Thomas Iron Company; E. S. Wheeler, of E. S. Wheeler & Co.; William H. Wallace, of William H. Wallace & Co.; John B. Cornell, of J. B. & J. M. Cornell; and Chester Griswold, of the Albany and Rensselaer Iron and Steel Company. Mr. Brinsmade is President; Mr. Bedell, Secretary and Treasurer; Mr. William Allen Smith, Assistant Secretary. Mr. Brinsmade made an address explaining fully the object of the new exchange, and predicting bright prospects of success. He was followed by Gen. Stewart L. Woodford, who had many pleasant things to say, finally making way for a general outburst of oratory from *nearly* every one of the stockholders. Many new names were added to the membership of the Exchange. The regular transaction of business began on the following day.

BEFORE HIS TIME.

The history of the world proves that almost every decided advancement in civilization was foreshadowed more or less completely by men of advanced knowledge, who are commonly said to have been "before their time." Mankind has often, by writers and speakers, been divided into classes, and we may, therefore, follow the example so often set, and look upon men as consisting (1) of those who think they see far enough forward to propose for adoption something nearly akin to perfection. This class has little business acumen, and would have the world move forward by leaps and bounds. A good example of this class is to be seen in the modern sanitarian, who preaches perfection and anathematizes the world because it does not act at once. Our houses, our cities, our children, ourselves are to be healthy and happy if we would but follow the golden rules so energetically put forward. Few of these men do any good. They, in fact, aim at cheap popularity and election in certain select societies. They obtain their desires, and the world jogs on without ever considering that, according to these men, "what is is wrong."

The second class of men is of a different stamp. It is to them the world owes its progress, and we would that more belonged to this class. These men are as farsighted as those in class 1, but combine a modicum of common sense with extensive knowledge. They know that the world moves slowly. They know it costs money to change all that exists, and that any attempt to change rapidly will be frustrated, because the necessary money is not forthcoming. They, therefore, take the world as they find it, and suggest such improvements as are practicable under the circumstances. It is to their efforts, persistent through evil and through good report as they have been, that we owe what little improvements we have in sanitary and other matters. Towns of health, though the description may cause a flutter through the ranks of an amateurish and *dilettante* society, are not, and will not be, built, for the simple reason, it would not pay.

The third class to which we would refer includes all those who are quite convinced that "what is is best." They would have no change, minor or fundamental.

Our readers can study these different classes for themselves, and decide to which they would belong. We have long ago come to the conclusion that the man who keeps but slightly in advance of his fellows, while, however, his knowledge extends far ahead, is the man whom the world should delight to honor.—*Contract Journal.*

CONCERNING STREET PAVEMENTS.

Of all the streets of all the cities in the world, it is safe to say that those of Chicago at present are the filthiest.—*Chicago Tribune.*

They cannot be worse than those of Cincinnati, which are impassable from ill repair. There are few streets in the Ohio metropolis through which carriages can be driven at a trot, the pavement being full of holes, and horse-car tracks miserably kept. Western cities depend upon the contract system to repair and clean their streets, and it is a sorry failure. Cleveland is well-paved with limestone blocks, and better kept than the average; but her famous Euclid avenue out to the tomb of Garfield is in execrable shape, the asphalt and wooden experiments having been all cut to ribbons. No city in the country has streets so well dressed as those of Washington, where the mild climate enables the asphalt, the ideal pavement, to retain its toughness, as it does at Paris. More northern cities cannot use it; neither can those which have a heavy draying business, necessitated by manufacturing industries. As to stone-paved streets, those of Boston are kept in the best order. A city with shabby streets is a dear place to do business in, for the first requisite of a public place for the congregation of human beings is not met. To have good streets, every city should establish a responsible one-man power to direct the outlay of the funds appropriated, answerable to the executive of the city for the neglect of duty.—*Springfield Republican.*

COST OF LIVING AND LABOR IN NEW YORK.

Thousands of families, educated, refined, fastidious, have not, from all sources; more than $2,000 a year, and yet they manage to live, even to present a fair outside appearance. But they must practice no end of self-denial, and make any number of shifts and turns to eke out subsistence with so little money. Five thousand dollars is really as small a sum as a family consisting of man and wife and one or two children can live on here with any degree of comfort; and they who have $5,000 are as one in a hundred. In no city on the globe, I dare say, is there so much friction and wistfulness among educated persons over the prosaic business of making both ends meet as there is in New York. I wonder why people without income proper are willing to stay here, when they might dwell elsewhere with so much less wear-and-tear of nerve and mind. But it seems as if everybody wanted to come to New York, with or without prospects, whether they are competent or incompetent. It is always so with a great city, which, like all great bodies, attracts by a natural law. Hundreds and thousands who ought to have demonstrated their inability to get on in the smaller towns, hurry to this multitudinous center, vainly hoping that it will change their nature by lending them an efficiency never before revealed. We are constantly hearing of the struggle for wealth in New York. There is a great and interminable struggle; but it is simply the struggle for existence; since not one in a thousand of our entire population has the least reason to believe that he will be wealthy, or regards wealth except as he might look after the unattainable. Mechanics seem, just now, to have better prospects than any other class, unless they insist on wages that will not be paid. There has been more advance in their wages proportionately during the last year and a half than in the prices of any other kind of labor. Their demands are so great that it is thought building will hereafter be far less active than has been anticipated. I imagine, however, that the demands will be met, as they always are, and that the city will continue to push ahead at an amazing rate. I doubt if there would be any objection to giving mechanics all that they ask, if the bulk of them were competent. But they are very incompetent, more so than they have been for years. Most of the houses erected recently have been ill-constructed from this cause; builders saying that it is almost impossible to get any number of good or competent workmen. Any number of careless fellows who have not half learned their trade have flocked to the city, prompted by the high prices. It is thought that a great many of the tramps who used to infest the country have gone to work in an indifferent way, and have really done more harm by their spasmodic diligence than they did by their habitual vagabondage. I have never heard so much complaint of poor work by carpenters, plasterers, plumbers, painters, masons, steam-fitters and the like, as within the last 18 months. The complaints, too, are well based, as results attest. Many houses, especially dwellings, put up recently, will have to be virtually rebuilt, and several are rebuilding now. The wood-work, plastering, brick-work and everything else is so poor as to be rapidly coming to pieces, and to demand therefore immediate reconstructions. It costs more in money, not to speak of time and interminable bother, to build a poor house twice than to build a good house once, as a number of our citizens are discovering to their sorrow.—*Correspondence Springfield Republican.*

THE NEW LOTS WATER DISPUTE.

The suit of Joseph Schluchtner, Jacob W. Erreger and others, taxpayers of the town of New Lots, against the Town Board and the Long Island Water Supply Company, came up in the Special Term of the Supreme Court this morning before Judge Pratt. The action is brought for an injunction and that the contract with the company be declared void. The matter has been in dispute for some time. A contract was made for 25 years with the water company to furnish water to the town at an annual cost of $15,500, the company to lay the pipes. The citizens' association of the town fought the matter and brought it into court. They claim the amount for which the contract is let is too large. The complainants allege that in 1881 taxes amounting to $44,155.18 were levied in the town; that the majority of the taxpayers are persons of limited means, who could ill afford to pay the rate demanded. In July last certain persons made application to the Town Board for a contract to supply the town with water. Plaintiffs claim the application did not comply with the requirements of the law; that the board granted the application without ascertaining if the water to be furnished was wholesome. On the 20th of July, 1880, other parties made application to the Town Board for the contract, but that the board wrongfully refused to consider the application; that certain of the town authorities wilfully absented themselves from the meeting called to consider the second application. It is further alleged that there was no competition in giving out the contract, and that three members of the Town Board refused to sign the contract with the Long Island Water Supply Company, and that it was signed by the other members of the board, who were the very men who prevented competition. The contract calls for 200 hydrants, and in this the plaintiffs claim a fraud was committed, as the number is greatly in excess of the number needed by the town; that thirty would be enough.

The defense is a general denial. For the taxpayers, Judge Samuel D. Morris; for the Town Board, Joshua Van Cott and William D. Veeder; for the water company, Jesse Johnson. The case is still on.

SEWER GAS.

In our April number we presented the preamble, and certain very judicious and sound conclusions on the dangers of privies and cesspools in villages and small cities, deduced from the report of Mr. James T. Gardiner, Director of the New York State Survey, and one of the members of the State Board of Health, on the various systems of sewage disposal recently observed by him in some of the chief cities and small towns of England. Mr. Gardiner has evidently observed carefully, and has come to wise conclusions, in the main, on the advantages of the separate system of sewerage and storm-water conduits, but he is too sweeping in his conclusions—regardless of all circumstances, and the possible advantages of combining both systems (the separate and combined)—under certain conditions. And he goes very much out of his sphere, both as surveyor and engineer, to pronounce judgment from any light he has thrown on the subject, when he asserts that, "It is time to call attention to the *fact* that no such gas as '*sewer-gas*' exists, and that *there is absolutely no proof that the diseases which attend the admission of sewer air into a dwelling are produced by gases.* On the contrary, the whole tendency of modern investigation is to show that the zymotic diseases are produced by *bacteria*, whose germs are developed under favorable conditions. It is well known that the most favorable conditions for the growth of these low organisms are heat, moisture, darkness, and the *presence of ammonia*. The damp walls of sewers present, therefore, all the requirements for a most flourishing growth of bacteria, whose germs may float off on the sewer-air and be carried into dwellings by mechanical action, and dust is borne on any air current." This, in the face of such searching investigators as Curtis, Satterthwaite, Senator, Billroth, Lebert, Wagner, Beale, Jacobi, Wood and Formad—and many others cited by these last-named and most recent searchers—who have failed to find, and several of them utterly deny the bacterian origin of zymotic diseases—is, to say the least, a very rash conclusion on the part of Mr. Gardiner, who throws no light on the subject. What he says about the filthy, damp walls of sewers unnecessarily large, is unquestionably true; and that such holds of filth in the process of putrefaction are far from being devoid of danger, is equally true. But that the myriads of bacteria and other low organisms which flourish and die in such places, in conjunction with the putrefying matter on which they feed, without giving off any gases of decay—any "sewer gas," as it is commonly called—and that such cases are innocuous, while the living bacterian scavengers there found, fulfilling their chief purpose of converting putrefying organic matter into *living* matter, are the sole cause of zymotic diseases, is in much greater need of proof then the mischievous effect of sewer air *per se*.—*Sanitarian.*

WORCESTER SEWERAGE.

Since the report of the experts of the State Board of Massachusetts, published in No. 19 of ENGINEERING NEWS, a bill has been reported in the State Senate of Massachusetts of the following character:

The city of Worcester is directed within two years to enter upon the work of purifying from all offensive, contaminating, noxious and polluting properties, the water or substances that may thereafter be discharged from its sewers into Blackstone River, so that said waters and substances shall not of themselves or in connection with other matter, create a nuisance or endanger the public health. After five years the city shall cease to empty any substances into the river until purified to the satisfaction of the State Board of Health. The compelling of pollutors to cease their pollution, the taking of lands and the raising of money are further provided for in a general way.

The only objection to the bill would seem to be its local bearing. Such a bill is demanded by the best interests of the community at large, and we scarcely doubt that Massachusetts will set the example in this matter of the public health.

CONGRESSIONAL NOTES.

Bills for the erection of public buildings in the following places have been introduced in Congress during the past month: Natchitoches, La.; Camden, N. J.; Lima, O.; New Castle, Del.; Wilmington, Del.; West Chester, Pa.; Chester, Pa.

The Committee on Public Buildings and Grounds reported favorably on bill for erection of public building at Paterson, N. J.; Jefferson City, Mo.; Carson City, Nev.; Lynchburg, Va.; Quincy, Ill.; and for extension of Executive Mansion at Washington.

Bills were passed for public buildings at Syracuse, N. Y.; Hannibal, Mo.; Frankfort, Ky.; Detroit, Mich.; Jackson, Tenn.; Denver, Col.; Greensboro', N. C.; Council Bluffs, Iowa; Lynchburg, Va.; Peoria, Ill.; Galveston, Texas; Quincy, Ill.; and Hannibal, Mo.

Among the miscellaneous bills passed was one for the erection of a monument to Thomas Jefferson; for an immediate appropriation of $50,000 for removal of obstructions at Hell Gate, N. Y., and an immediate appropriation to continue work on the Washington monument.

WASHINGTON, D. C., May 8, 1882

The House Committee on Manufactures have agreed on the bill authorizing the President to appoint a commission of seven experts skilled in the investigation, production and use of metallic substances and other structural materials, to execute tests and experiments on iron, steel and other materials used in the construction of bridges, buildings and mechanical structures.

The House Committee on Public Buildings and Grounds have agreed to recommend an appropriation of $75,000 for a public building at Dayton, O., and $25,000 for one at Jefferson, Tex.

The House Committee on Indian Affairs to-day agreed to recommend concurrence in the Senate amendments to the bill granting right of way for a railroad and telegraph line through the lands of the Choctaw and Chickasaw nations to the St. Louis & San Francisco Railway Company.

THE NEW CHINESE BILL.

The bill provides that from ninety days after its passage the coming of Chinese laborers to this country shall be suspended for ten years; that any master of a vessel who knowingly lands Chinese laborers in this country shall be subject to a fine of not more than $500 for each laborer, and the Chinese laborer himself shall be subject to imprisonment for not more than one year; Chinese laborers who came here before November 17th, 1880, or who shall come before the expiration of ninety days after the passage of the bill, are excepted; that the excepted Chinamen shall be registered by collectors of customs, and furnished with certificates to show their right to come to and go from the United States of their own free will; that Chinamen who are not laborers shall be identified by a certificate of the Chinese Government to show that they are entitled to come to this country; that no Chinamen shall be permitted to enter the United States by land without producing such a certificate; that the credentials of diplomatic and other officers of the Chinese Government traveling upon the business of that Government shall be taken as equivalent to such certificates, and shall exempt them and their servants; that hereafter no State or United States court shall admit a Chinaman to citizenship; that the words "Chinese laborers" shall be construed to mean both skilled and unskilled laborers and Chinese employed in mining. There are other sections providing for the punishment of the making of false certificates and for the removal of Chinese who may come into the country by land contrary to the provisions of the act.

The bill has been approved by the President.

NOTES.

FRANKLIN INSTITUTE MEETING.—At the meeting of the Franklin Institute on Wednesday night, C. Colon, representing the De Lesseps Canal Company, read a long paper describing the work done preparatory to cutting the Panama Canal, and said that the company would demonstrate that it was not in any sense anti-American, but was, on the contrary, deserving of the full sympathy and support of the American people. Professor Houston called attention to the dangerous character of the sewage emptied into the Schuylkill River near the eastern end of Girard avenue bridge, close to the Spring Garden Water-Works, and within less than a mile of the Fairmount Works. On motion of Mr. Chabot, the president was authorized to appoint a committee to prepare a memorial to Councils on the subject, to be submitted to the Institute at its next meeting.

BUILDERS' QUANTITIES.

A cord of stone, three bushels of lime and a cubic yard of sand will lay 100 cubic ft. of wall. Five courses of brick will lay one foot in height on a chimney. Nine bricks in a course will make a flue 8 in. wide and 20 in. long, and 8 bricks in a course will make a flue 8 in. wide and 16 in. long. Eight bushels of good lime, 16 bushels of sand and one bushel of hair will make enough mortar to plaster 100 square yards. One-fifth more siding and flooring is needed than the number of square feet of surface to be covered, because of the lap in the siding and matching of floor. One thousand laths will cover 70 yards of surface, and 11 pounds of lath nails will nail them on. One thousand shingles laid 4 in. to the weather will cover 100 square ft. of surface, and 5 pounds of shingle nails will fasten them on.

THE NEW RAILROAD BRIDGE OVER THE DES MOINES.—This structure is the design of Mr. Kinney, Chief Engineer of the St. Louis, Des Moines & Northern Railroad, assisted by Mr. Chas. F. Loweth, recently of the Edgemoor Iron Works. It was erected by Messrs. Raymond & Campbell, of Council Bluffs, Ia. It is a "combination" bridge, 2,020 ft. long, including approaches, the bridge proper being composed of two spans of 175 ft. each, between centres. It is 101 ft. above ordinary water in the river, the water below ranging from 6 to 14 ft. depth. It is supported on eight large iron cylinders, with the usual piers and trusses. The largest cylinders are 31 ft., the others 27 and 29 ft. The piers are 52 ft. high from the top of the cylinder to the lowest truss. The truss is 28 ft. high. In sinking the iron cylinders they passed through first a bed of sand, next a bed of bowlders, and are now resting on a bed of soapstone rock. The structure contains 742,000 ft. of pine lumber, 175,000 ft. of oak and took 19,000 lineal feet of piling. The highest bent of the trestle is 93 ft. high. It was begun about the middle of last August, and would have been completed before this but for delay in receiving iron and lumber.

THE OLDEST TIMBER.—The ancient temples of Egypt are believed to contain the oldest timber in the world, in the shape of dowel-pins, which are incorporated with stone work known to be not less than 4,000 years old. These dowel-pins, according to the appearance they present, are thought to have been made from the tamarisk or shittim wood, in ancient times a sacred tree in Egypt.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

LONDON EAST, Ontario, wants $40,000 worth of water-works.

THE Erie, Pa., Gas Company is about to rebuild their works, the present establishment being inadequate in size for the purpose.

HIGH AND LOW PRESSURE.—The Boston *Journal* says: "The Beverly authorities complained of low pressure in their supply a number of months ago, and the Salem Water Board went to an expense of $4,000 to give a higher service, and this has been applied with a result of bursting the pipes in many places. The Beverly people now say "Enough," and in compliance with their request the Salem authorities are lessening the pressure.

WANTS TO BUILD WATER-WORKS.—The Common Council of Plainfield, N. J., has received a proposition from a company of capitalists to supply the city with water. Action will probaby be taken at the first meeting in June.

NEW PUMPING ENGINE.—The Columbus, Ohio, Water Board recently ordered a 10,000,000 gallon engine of the Holly Manufacturing Company, for addition to the present pumping capacity of the city water-works, the engine to be built after a new design with compound steam cylinders, double pumps, crank and fly wheel, and to show a duty of 85,000,000 foot-pounds of water per 100 pounds of coal.

CONCORD, N. H., WATER-WORKS.—The Committee on Prisons has reported a resolve providing for the taking of water for the domestic and other uses of the State Prison at Concord, N. H., from Lake Magog, in Acton, at an estimated cost of $60,000, of which $45,000 are to be expended for construction and $15,000 for land and water damages.

NEW WATER-WORKS.—Corsicana, Texas, has voted for water-works, to cost $75,000, the contract to be entered into at once.

SUING FOR DAMAGES.—The Blackstone Valley manufacturers are suing the City of Worcester, Mass., for $234,000 for pumping water after the giving way of the Lynde Brook reservoir dam.

ADDITIONAL WATER SUPPLY.—The Department of City Works, of Brooklyn, contemplate sinking a large well near their pumping station at Rockville Center.

NEW PUMPING ENGINE ORDERED.—A new pumping engine to cost nearly $400,000 has been ordered for the water-works at Cincinnati, O.

CHICAGO WATER BONDS.—The most favorable bid for the purchase of the issue of $333,000 of the water bonds, bearing interest at the rate of 3.65 per cent., was that of the First National Bank. It offered a premium of $4.10 on the $1,000.

W. C. MCCLALLAN, of Springfield, Mass., has made proposals to the commissioners of Wallingford, Conn., to construct the water-works of that borough, and will probably receive the contract. There will have to be another meeting of the voters to issue bonds, which, it is expected, will sell at once at a premium of 3 pe cent., which will go a long way toward paying the first year's interest. Mr. McClallan expects to finish laying the pipe by Jan. 1.

THE supervisor of Lake View, Ill., was authorised to advertise for furnishing and laying water-pipes in all streets where pipes have been ordered laid, and to advertise for coal for the use of the water-works for the ensuing year; also for constructing sewers on Evanston avenue, George avenue and Dempster place.

ELECTRICITY.

LAFAYETTE, Ind., is in favor of supplanting gas in that city with the electric light.

TELEGRAPH PROJECT.—It is stated that a company will soon be formed in Boston for the purpose of building a telegraph line from New York to Chicago.

EVANSVILLE, Ind., has contracted for the Brush electric light, and the Elgin Tubular Iron Tower Company will furnish six towers, 250 ft. high, and a Detroit firm the engine, boilers, etc., for the works. It is claimed that the city will be illuminated by the light in 90 days.

LIGHT IN MINNEAPOLIS.—It is proposed to erect as soon as possible a tower 150 ft. high at the east end of the city hall, for four electric lights of 2,000 candle-power each. In the opinion of the company this will illuminate a radius of fully one-half mile.

THE Edison Electric Light Company has laid about 67,700 ft. of conductors underground in New York City, and has yet to lay about 14,300 ft. Rapid progress is being made toward completing the arrangements for lighting what they call the First District, and it is expected that the light will be turned on within a few weeks.

STREETS, DRAINAGE, ETC.

OCONOMOWOC, Wis., will soon advertise for bids for about 1,000 ft. of sewers.

PAVEMENT DEFERRED.—Both the granite and cedar block pavement schemes for Washington Ave., Minneapolis, have been abandoned by the city council.

FOR MACADAMIZING Kinzie street, from Peoria to Morgan street, Chicago, the lowest bid was that of Jencks & Thatcher, who offered to do the work for $1.43 per square yard.

A $25,000 ROAD.—The House, under a suspension of the rules, has appropriated $25,000 to be expended under the direction of the Secretary of War in grading and macademizing a road from Mound City, Ill., to the national cemetery, one mile distant.

PHILADELPHIA proposes to spend $20,000 in Rittenhouse Square improvement, and also other moneys on improving other public squares.

MINNEAPOLIS is still undecided on the paving question. The streets need it, the people demand it, but the City Council is trying to solve the problem "Which is the best?"

NEW PAVEMENTS TO BE LAID.—The Commissioners have made an order that the engineer department, Washington, advertise for proposals for laying pavements as follows: Asphalt pavements on C, between 3d and 4½ streets northwest, and 16th street, between Scott circle and R street northwest; granite block pavements on C, between 1st and 3d northeast: 3d street, between C and D northeast; C, between 2d and 3d streets northwest; 1st street, from Massachusetts avenue to H street northwest; 1st street, from Defrees to I street northwest; 28th street, from Pennsylvania avenue to K street northwest; 29th street, from M to N street, Georgetown; for grading and regulating South Capitol street from N street to Eastern branch.

RIVERS AND HARBORS.

The 50 tide breakers at Gangway ledge in Portsmouth harbor, to protect government contractors while removing the ledge, have been carried away by high tides.

Ontario Light-Houses.—Out of the amount of $40,000 in the supplementary estimates for 1883 for light-houses, the following are for Ontario: Two new lights in the Algoma district, namely, Cape Robert and Missuqua Island, $4,000; light-house at Hope Island, Georgian Bay, $3,000; light-house at Port Credit, Lake Ontario, $2,000; light house at Colchester Reef, Lake Erie, on account, $10,000; small lights upper Ontario, $400.

Buffalo Harbor entrance needs dredging badly.

Pier Improvements.—Work has begun on the pier improvements at Oconto, Wis.

A paragraph in the River and Harbor bill provides "that hereafter no survey of a river or harbor shall be made by the Secretary of War until after the latter shall have detailed the local engineer to make a preliminary examination of said river or harbor and reported upon the question whether there is any good reason or justification for making the proposed survey." This provision will, it is believed, prevent the expenditure of much labor and money in preliminary surveys of creeks and inlets. One member asked the committee last week to provide in the bill for 20 of these surveys.

RAILROADS.

The N. & W. R. R.—The net earnings of the Norfolk & Western Railroad for March were $67,161, and for the first three months of the year they were $187,236, being a decrease as compared with the same period of 1881 of $34,412.

New Reorganization.—The list of new crop railway enterprises requiring financial reorganization already includes the Toledo, Delphos & Burlington, Connotton Valley and the Massachusetts Central, with a very good prospect that the list will be greatly extended before many months. It is not likely, however, that the number will compare at all with the list furnished by the panic of the last decade.—*Boston Journal.*

A mysterious survey for a railroad from Wheeling, W. Va., to Harrisburg, Pa., is in progress, and people down that way are hoping that Jay Gould and actual construction are behind it.

Storage of Unclaimed Baggage.—All the railroad companies terminating at Chicago have determined to place in public warehouses all baggage brought in by their trains that is allowed to remain in their depots more than 24 hours after its arrival. This determination has been brought about by the fact that it has become almost a custom for incoming passengers to allow their baggage to remain in the depots here for periods ranging from a week to two or three months; and the result has been that all of the baggage-rooms are so crowded that it is almost impossible for the railroad companies to handle baggage of out-going passengers. The railroads have determined to charge 25 cents storage for the first day, and from 10 to 25 cents for each subsequent day after the first that the baggage is held in their warehouses. The railroad companies will hold the baggage free of storage 24 hours and no more after its arrival at Chicago. This new rule will take effect on most of the roads Wednesday, May 10, and on all of them by Thursday, June 1.

During the month of April 38,100,000 pounds of ore passed over the Nashville & Chattanooga Railroad through Chattanooga, Tenn., and since Jan. 1, 1881, 200,000,000 tons have passed over the road.

A Contradiction.—The builders of the New York, Chicago & St. Louis Railroad reply in detail to the statements contained in a circular issued by a firm of brokers. The reply is as follows:

Our attention has been called to a circular letter issued by Messrs. Breese & Smith, brokers, in which certain statements are made regarding the New York, Chicago & St. Louis R. R. Co., which are calculated to alarm the holders of the securities of that company. We briefly answer the main assertions. Messrs. Breese & Smith say: Firstly, that no contract has been made with the Illinois Central R. R. Co. for the use of their terminal facilities in Chicago. This is false. A contract has been duly executed by the proper officers of both railroad companies, and approved by the board of directors, for the use of all the terminal facilities which the company will require in Chicago. Secondly, they state that the road is not laid with steel rails, but old rails. This is false. The entire line is laid with new steel rails of the best quality. Thirdly, they state that the trestles along the line are of wood and insecure. This is false. The bridges and trestles are of iron, with stone abutments, except in some places where temporary trestles are used until the same can be filled with earth. Fourthly, they assert that the entire funds of the company are exhausted, and the company has not the means for finishing the road. This is false. The company has raised all the funds necessary to thoroughly build and equip the road. Fifthly, they assert that the company will own no rolling stock, but have made a contract by which the rolling stock is leased by the Messrs. Pullman. This is false. The company has already purchased $6,000,000 worth of rolling stock, separate and in addition to the contracts with the Messrs. Pullman, which relate only to sleeping-cars, and is similar to the contracts with the Pennsylvania Central R. R. Co. and other large railroad companies. Sixthly, they say that the bonded debt of the company is unlimited. This is false. The limit of the mortgage debt is $15,000,000. Seventhly, they assert that no grounds are secured in South Chicago for shops. This is false. The Calumet Canal Company, of Chicago, has agreed to donate 60 acres of land in South Chicago to the company for the erection of shops. If the assertions had been mere matters of opinion, we would not have noticed them; but where a firm publicly make assertions as facts which are absolutely false, and regarding which they could have readily ascertained the truth by making inquiries either at the company's offices or at our own in this city, we think we owe it to the holders of the securities of the company to contradict them.

Brown, Howard & Co.,
Contractors.
B. G. Mitchell,
Secretary and Treasurer.

Road to be Sold.—Judge Graham has granted a decree in the United States Court, in Indianapolis, for the foreclosure of the second and third mortgages on the Indianapolis & St. Louis Railroad, suit having been brought by H. B. Hurlbut, trustee. The second mortgage is for $1,000,000, and the third mortgage $500,000, and the sale is subject to the first mortgage of 2,000,000. The Court ordered that in the event of the amount due not being paid into Court within ten days, the road is to be sold within fifty days of the date of the decree. The parties interested in the property are the Bee Line, the Pennsylvania Company, and the St. Louis, Alton & Terre Haute railroad companies, the latter owning that portion of the road extending from Terre Haute to St. Louis.

Progress in Texas.—The Galveston *News* says: Iron is laid on the Trinity & Sabine Railway to the thirteenth mile. Work was delayed a short time on the tenth mile by a widow and a shotgun. The widow threatened to shoot the first man who stepped on her land. The matter was finally settled, and the widow agreed to leave her shotgun at home. Superintendent Harding is out to the end of the line inspecting timber and looking up the best route to be taken.

Beyond the Missouri.—A dispatch from Cheyenne says: "Articles of incorporation of the Dakota, Wyoming & Western Railroad Company have been filed here, providing for the continuation of the main road from the Eastern Wyoming line to the Yellowstone National Park; also a branch line from Cheyenne north to intersect with the main road near Hot Creek. The length of the road to be built in Wyoming is estimated to be 500 miles. The capital of the company is fixed at $12,500,000."

J. T. Odell, General Superintendent of the Chicago, Texas & Mexican Central Railroad, says that satisfactory arrangements have been made to pay off the indebtedness of the road and relieve it of all embarrassments preventing construction.

Jamaica Railways.—Messrs. Reid & Mackay, of 13A Great George street, S. W., London, have in hand the contract for the construction of the Jamaica Government Railway Extensions.

New Railroad Company.—An Albany (N. Y.) dispatch of the 16th says: "The articles of the association of the Schenectady, Albany & North Adams Railroad Company were filed to-day. The road is to extend from Schenectady to Albany, cross the new bridge, and thence on to North Adams and the Hoosac Tunnel, the whole length being 72 miles. The capital stock is $2,000,000, divided into shares of $100 each.

Dominion Affairs.—Winnipeg, Man., May 16.—The Government General Railway act, which was introduced to secure the building of railways in the province has been withdrawn, bitter opposition having been manifested to some of its provisions.

The Texas Pacific.—But ninety miles of track laying remains to be done in Texas to make a through railroad connection between San Francisco and New Orleans. It is expected the work will be completed Sept. 1.

Columbus, O., is talking of an elevated railroad.

A survey is now being made of the Duluth & Iron Range Railroad.

The St. Paul & Duluth road has just laid 15 miles of steel track in place of iron, beginning at Rush City and going north. In all, 86 miles of steel rail are to be laid this season, leaving about 27 miles more to be finished. By the 1st of June there will be, in all, 129 miles of steel track in the road. The company is also putting in 100,000 ties and using 100 cars of gravel daily in ballasting from Rush City north.

The Canada & Atlantic.—Work on the Canada & Atlantic Railway is progressing rapidly. It is expected the road will be completed in the course of two months.

Pennsylvania Railroad.—Construction of a branch from Pocomoke City, Worcester County, Md., to Cherrystone, Northampton County, Va., about 50 miles distance, is soon to be begun.

The Chicago, St. Louis & Western Railroad Company is incorporated. It is to be practically an extension of the Chicago, Pekin & Southwestern road to Chicago, and will be only 33 miles long.

The Pemigewasset Valley Railroad (N. H.) contractors, unable to secure enough Irish employés, are bringing numbers of Italians to work on the dumps.

The New York, West Shore & Buffalo Railway Company will erect a round-house and repair shops in Kingston, N. Y. The bridge across Rondout Creek, where the road will enter that city from the south, will be of iron and very substantial. It will be 150 ft. above the water and nearly 700 ft. long. The two main spans will be 255 ft. and 235 ft. in length respectively. The piers will be of iron resting upon solid masonry.

The Dakota, Wyoming & Western Railroad Company has filed papers of incorporation to provide for the continuation of the main road from the Eastern Wyoming line to the Yellowstone National Park; also a branch line from Cheyenne north to intersect with the main road near Hot Creek. The length of the road to be built in Wyoming is estimated to be 500 miles. The capital of the company is fixed at $12,500,000.

Railroad Consolidation.—The New River Railroad Company, of Virginia; the New River Railroad Company, of West Virginia, and the East River Railroad Company, whose lines have been controlled and under construction by the Norfolk & Western Railroad Company, have been consolidated into the Norfolk & Western Railroad Company. The roads thus acquired will be known as the New River Division of the Norfolk & Western Railroad Company, and will be in operation in the early autumn.

New Washington Territory Road.—Cheyenne, W. T., May 18.—Articles of incorporation of the Dakota, Wyoming & Western Railroad, filed here to-day, provide for a continuation of the main road from the eastern Wyoming line to the Yellowstone National Park; also a branch from Cheyenne north, to intersect with main road near Hat Creek. Five hundred miles is estimated as the length to be built in Wyoming. The capital is fixed at $12,500,000.

The sum of $100,000 is wanted to build the proposed railroad from Gettysburg to Hunter's Run, Pa.

New Illinois Project.—Articles of incorporation of the Chicago, St. Louis & Western Railway Company have been filed. The new line is to be 33 miles long, running from the terminus of the Chicago, Pekin & Southwestern at Joliet to a connection with the line of the Chicago & Western Indiana, near Dalton.

The Mexican Central.—From a Mexican correspondent we have received the following: The grade is virtually completed to the City of Chihuahua, 224 miles south, and track is laid 167 miles. Contractors are moving to the first 50 miles south of Chihuahua. It is probable that the first week in June will see regular trains running into that city and contractors strung out for 100 miles south. On May 4 the road was opened for business from Pass del Norte to Gallego, 140 miles south, and regular passenger trains are running each way daily.

BUILDINGS.

New Town Hall.—An extra appropriation of $15,000, making about $50,000 in all, besides the lot, will be asked to build the town hall, Adams, Mass., according to the plans. There will be a close fight over the matter at to-day's meeting, and the feeling is pretty general that the $35,000 appropriation made last spring, besides the $10,000 given by the county, is large enough.

Hotel.—The hotel which is to be built by Mr. Mackay, the millionaire, in London, will be five times as large as the largest of London hotels.

Overworked Officials.—The mayor bet Supt. Kirkland that the east wall of the new city hall was not more than one inch out of plumb. The mayor lost and paid the bet—a gallon of whisky—yesterday.—*Chicago Times*, 6th.

Court-House and Jail.—The county seat of Mackinac county, Mich., is to be moved from the village of Mackinac to St. Ignace, on the 15th of September next, and the supervisors have adopted a resolution for a special election on June 5 to submit to the people a proposition to issue bonds for a loan of $17,000 to build a court-house and jail at St. Ignace.

Court-House.—Johnson Co., Texas, is to build a new court-house.

Damaged Custom House.—The magnificent granite custom-house building in New Orleans was damaged by fire on the 11th to the extent of $60,000. Supt. J. W. Glenn reports: The fire has destroyed all the frames, sash and glass of the openings, and the offices from the basement to the roof, including my office, are exposed to the weather. The iron cornice is practically destroyed for nearly half the length of the custom-house street front. The columns at the entrance and the pilasters have their outline destroyed to such an extent as to make substitution necessary.

Court-House.—San Antonio, Texas, is to have a new court-house, for which a special tax has just been imposed. D. C. Anderson has the contract. Bond, $10,000.

College Building.—Ex-Gov. Charles H. Hardin, the founder of Hardin College, at Mexico, Mo., has just given to the institution $19,000 in cash to build a new wing to the edifice and make other improvements. This makes an aggregate of $70,000 which he has bestowed upon the college.

Opera-House.—Plans have been prepared for a new opera-house in Yonkers, N. Y. It will be 72 ft. front and 75 ft. deep, with chairs for 658 persons.

A Marine Hospital.—A United States Marine Hospital will be erected at Cairo at a cost of $75,000.

The St. Louis Custom-House is in need of money to complete it and expects to get it in the sundry civil bill.

Smelting Works.—The Marshall Car and Foundry Company will erect smelting works at Marshall, Tex. Cost $50,000.

Court-House.—The new court house at Havanna, Ill., is rapidly nearing completion.

Granite Building for this City.—The president of the Farmers' Loan and Trust Company has submitted to the Bureau of Buildings a plan for a granite building for the use of the company. It will have a frontage of 45 ft. and an average depth of 71 ft. Estimated cost $180,000.

New Church.—Plans are now being prepared for the erection of a new Catholic church at Rockford, Ill., to be located on the West Side.

Want to Make Iron and Steel in Canada.—A number of gentlemen belonging to Ottawa, New York and Niagara Falls have applied for a charter for the establishment of a new iron and steel manufactory in the vicinity of Three Rivers. The company is to be called the Franco-American Mining and Manufacturing Company, with a capital of $500,000.

School-House.—Kewanee, Ill., wants a new school-house.

Residences.—Mr. Wm. H. Vanderbilt has selected the designs of Mr. Charles B. Atwood, for the houses he proposes to erect on Fifth avenue and Fifty-fourth street; Mr. J. B. Snook will be the constructive architect.

Chapel.—A memorial chapel and mission, 66 ft. 6 in. × 118 ft., is to be built on the corner of Avenue A and

Tenth street, N. Y., for St. Mark's Church. It is to be built of stone and will probably cost $100,000.

BUILDING COAL PIERS.—The Reading Railroad Company contemplate extending the coal piers at Port Richmond and constructing a new pier south of the grain elevator.

A DISPATCH from Cincinnati states that the county commissioners have resolved that all parties hereafter awarded contracts by the Board shall be prohibited from sub letting.

DELTA COUNTY, Mich., will build a $17,000 court-house.

ELEVATOR.—The material for the building of elevator C, at Duluth, Minn., is nearly all on hand, and the work of putting it together will be resumed as soon as the weather is more favorable. This elevator will be built this summer. Its capacity will be 1,000,000 bushels, bringing the storage capacity of the three elevators at Duluth up to 2,850,000 bushels.

BRIDGES.

THE MINNEAPOLIS VIADUCT.—Thirteen piers of the great Minneapolis viaduct are now built to above high water mark, and the contractor, E. Darragh, expects to have the remaining piers up to the same height by July 1. He expects to put in some of the centers by June 1.

DAMAGED BRIDGE.—By a rise of 15 ft. in the Brazos River on the 10th, all the false works of the Texas Western Railway bridge were washed away.

NEW BRIDGE CO.—Articles of incorporation have been filed by the Houston (Texas) Bridge & Manufacturing Co.—capital, $50,000—to build bridges and do a general manufacturing business. Directory: C. C. Wiggins, S. C. Oliver, B. C. Simpson, E. J. Heiner and R. J. Alexander.

THE work of widening the famous Magdalen Bridge, at Oxford, England, is already in progress. The extent of the enlargement will be about twenty feet, on what is known as the Botanical Gardens side, so that the side facing southwest, in which lies the chief beauty of the structure, will remain uninjured.

RAISING A BRIDGE.—In order to prevent future danger from floods the Canadian Pacific bridge at Brandon is to be raised six feet.

BRIDGING THE RIO GRANDE.—The iron piers for the first span of the international iron bridge at Laredo have been sunk to bed rock.

BRIDGE.—J. H. Leavitt, of Boston, having decided not to take the new bridge contract, at Lowell, Mass., awarded him for the stone work, the job goes to the next highest bidder, Cheney & Trumbull, for $73,840.50. The work is to be done by Oct. 10.

NEW BRIDGES.—The selectmen of Pittsfield, Mass., have contracted with H. S. Russell for two new iron bridges, each about 34 ft. long, one near Tillotson's mill on the Stearnsville road and the other at Barkerville, opposite Barker Bros.' mill.

BRIDGE FINISHED.—The Connecticut River Road trains now run over the new Cheapside bridge near Greenfield. Before the bridge was used it was thoroughly tested in the presence of President Leonard, Superintendent Mulligan, several of the directors and numerous railroad men. A locomotive, several flat cars, two or three cars of wet sand, weighing 60 tons each, two or three other cars weiging 40 tons each, etc., were run slowly over the structure first, and it deflected 11-16 of an inch. Then they ran across at the rate of 15 miles an hour and the deflection was 10-16 of an inch. The old bridge was burned September 21.

RAILROAD BRIDGE.—WASHINGTON, May 16.—The Senate bill to authorize the Rock Island & Southwestern Railway Company to construct a bridge over the Mississippi at New Boston, Ill., was passed.

LABOR.

MACHINISTS' WAGES in Connecticut range from $2.50 to $4.50 per day.

WAGES IN DELAWARE.—Most of the bricklayers and hod-carriers employed by four Wilmington builders, about fifty workmen in all, struck for higher wages. The bricklayers want $3.50, the mortar men $2.50 and the hod-carriers $2.50 per day, an advance of from 50 to 75 cents.

IN Grand Rapids, Michigan, wages for carpenters are from $2 to $2.50 per day. Mason's wages are from $3 to $4 per day. The demand is good for all kinds of mechanics, with a growing demand for carpenters and masons.

STRIKE.—Most of the bricklayers and hod-carriers of Wilmington, Del., have joined the strikers, and building operations are largely suspended. The strikers have formed themselves into an organisation and appointed a committee to wait on their employers. The latter say that they will not accede to the demands of the men, but will, in preference, cover up the work now under way and wait indefinitely.

STRIKE ENDED.—The strike of workmen in the Delaware rolling mill, Phillipsburg, N. J., ended on the 17th at 4 A. M., when work recommenced.

WAGES AND MATERIAL, KANSAS CITY, MO.—Material is said to be more abundant than last year and labor is easier to be had. Brick now can be put in the walls at from $8.50 to $9 per 1,000. Lumber of ordinary dimensions is selling at $24 per M., and wages are no higher than last year. Lumber is about $3 higher and hardware a little higher.

CARPENTERS' WAGES, BALTIMORE.—At a meeting held May 5 the Carpenters' Union decided to make a demand for $2.50 a day on and after May 8. Journeymen now receive $2.25 per day.

LABOR MARKET, PHILADELPHIA.—Some contractors are still refusing to grant the advance asked by the carpenters, and as a consequence their operations are retarded by the continued strike. The majority, however, have conceded the advance.

WAGES AT ST. CATHERINES, ONT.—Laborers on the canal have had their wages increased to $1.50 per day.

STRIKE ON A TEXAS RAILWAY.—Two thousand men employed on the Galveston, Houston & San Antonio Railway, in grading and general construction work, have struck for $2.75 a day. They were receiving $2.50. It is thought the demand of the men will be conceded by the contractors, as the work cannot stop.

STRIKE IN DELAWARE.—Most of the bricklayers, mortar-men and hod carriers of Wilmington, Del., struck for an advance of 50 to 75 cents.

CONCERNING BRICK.—The Bricklayers' union met at Greenebaum's hall, Chicago, on the 12th, and formulated the following proposition to the bosses:

"Finding the grievance existing between the manufacturers of brick and their labor has become a grievance to all who are interested in the prosperity of Chicago, be it

"*Resolved*, That we offer the following proposition to the bosses: That we will, as the Bricklayers' union, agree to work nothing but the brick manufactured by the bosses' union, providing they will agree to manufacture their own brick, and refuse to buy from the present monopoly."

THE MEXICAN CENTRAL RAILROAD calls for 2,000 laborers on the division between Lagos and Guadalajara.

OF COURSE HE PROMISED.—CRITTENDEN, N. M., May 16.—A mob took forcible possession of the railroad, drove the Chinamen from the camp, and hanged D. Scott, Superintendent of Construction, to a telegraph pole until he promised to hire no more Chinamen. *Ex.*

LITERATURE.

IN the *North American Review* for June, Senator W. B. Allison has a paper on "The Currency of the Future," in which he indicates the measures that will have to be taken by Congress for insuring a stable currency after the national debt has been extinguished. "A Memorandum at a Venture," by Walt Whitman, is an explanation of his purpose and point of view in trenching upon topics not usually regarded as amenable to literary treatment. "Andover and Creed Subscription," by Rev. Dr. Leonard Woolsey Bacon, is a philosophical review of the present state of dogmatic belief in the churches. Hon. George F. Seward, late Minister to China, in an article entitled "Mongolian Immigration," makes an argument against the proposed anti Chinese legislation. Doctor John W. Dowling, Dean of the New York Homœopathic Medical College, comes to the defense of the Hahnemannic School of Medicine, against a recent attack upon its principles and methods. O. B. Frothingham has a sympathetic article on Swedenborg. Not the least important paper is one entitled "Has Land a Value?" by Isaac L. Rice, it being a criticism of one of the fundamental postulates of Henry George's political economy. Finally, Charles F. Lydecker essays to prove that a "National Militia" is a constitutional impossibility.

"ALL IS VANITY AND VEXATION, ETC."—A new history of Penobscot County, Maine, done in Western style by a Cleveland firm, has just got a lot of the big and little fry of the county by the ears. It is claimed that ex-Gov. Davis paid $87 to have his picture put in and Gov. Plaisted's kept out, but the book holds the features of each hero, and Davis has actually brought a suit for $1,000 damages against the contractors for breach of contract. Dr. Calvin Seavey paid $150 for an honorable place in the book, but Dr. E. F. Sanger paid a bigger sum to get in and have Seavey left out of all the copies except one—and that one was sent to Seavey. This causes another suit for $1,000 damages. Finally, a flourishing limb of the law, B. C. Additon, who is mentioned as "dead," thinks he can convict them of one mistake at least, and sues them for $5,000.—*Springfield Republican*

CONTRACTS LET.

BOSTON, MASS.—The contracts for iron girders for the sub-treasury will probably be awarded to G. W. and F. Smith, at their bid of $8,160.

EAST BROOKFIELD, MASS.—The contract for building the new school-house has been given to A. D. Ward, of Brookfield, for $6,100.

FLATBUSH, L. I.—The contract for rebuilding and repairing that portion of the lunatic asylum which was recently destroyed by fire has been awarded to P. J. Carlin for $16,248.

WASHINGTON MONUMENT.—Bids for furnishing 39,000 cu. ft. of marble and 23,500 cu. ft. of granite for the Washington monument were opened on the 10th, and the lowest bidder for supplying the marble was found to be Hugh Sisson, of Baltimore, at 85 cents a cubic foot and, for the granite, the Borderell Company, of Maine, at 53 cents.

PITTSBURGH, PA., CONTRACT LET.—The contract for roofing the north wing of the Riverside Penitentiary was on Monday awarded to Riter & Conley at $42,700. The roof is to be wholly of iron and slate, the only wood in the whole building from cellar to roof being the floors to the narrow galleries in front of the different cell tiers and the inside window frames.

MANTLES.—Bids have been opened for furnishing mantles for the north wing of the State, War and Navy Department from Davidson & Sons, of Chicago; Chas. E. Hall & Co., of Boston; A. Klaber, of New York; A. L. Fauchere, of New York; Wentworth, Roberts & Co., of Boston; Hugh Sisson & Sons, of Baltimore, and Robert C. Fisher, of New York. Messrs. Hall & Co., of Boston, are probably the lowest bidders.

SUCCESSFUL BIDDERS to supply clothing, etc., to the army are the following: A. P. Olzerdam, Manchester, N. H., wool stockings; A. H. & B. C. Allang, Birmingham, Ct., cotton stockings; North Wayne Tool Company, Hallowell, Me., axes.

BIDS FOR GRANITE.—The lowest bid for supplying the granite for the Washington monument was from the Bodwell Company, of Maine, at 53 cents per cubic foot. The bid was accepted. The total amount is 23,000 cubic feet.

STONE STEPS.—The contract for cutting steps, etc., for outside of Hartford (Conn.) Post-office, has been awarded to the Clark's Island Granite Co. The building was cut on Clark's Island, Me.

BALTIMORE P. O.—The contract for furnishing the granite for the basement of the new post office at Baltimore, has been awarded to Gen. Davis Tillson of Rockland, Me., the lowest bidder. The bids were as follows: Davis Tillson, $64,950; Bodwell Granite Company, $68,915; Mount Waldo Granite Works, $69,445; Collins Granite Company, $74,401; Old Dominion Granite Company, Va., $77,000; Gill & McMahon, Woodstock, Md., $81,454; M. K. Chase, $88,500; Cape Ann Granite Company, $89,550; Charles Guidet, $104,447; Concord Granite Company, $114,933; J. B. Emory, Baltimore, $118,920. The granite will be furnished from the General's quarries on Hurricane Island, and will be cut there.

JAIL CONTRACT LET.—The County Commissioners of Meeker County, Minn., have let the contract for building a county jail in Litchfield.

MILWAUKEE SEWER CONTRACTS.—Contract for pipe sewer in Lloyd and Booth streets awarded to R. Chambers for $2.42 per lineal foot.

CHICAGO has let contracts for the improvement of several streets. Some bids received were above the assessment, and will be re-advertised.

STONE CANAL.—The bids for the building of a stone canal 1,500 ft. long, and filling the flats on both sides from Dean street bridge to Frye's Mills in Salem, were opened at the City Hall and were as follows: J. H. Leavitt, Boston, $52,000; Balcomb & Co., Salem, $56,080; Conrad, Jewell & Co., Danvers, $58,550; Parsons & Peterson, Salem, $60,458, and the contract was awarded to Mr. Leavitt. The work is to be completed by Nov. 1, 1882.

CONTRACT SIGNED. A contract has been signed by Roger & Ballentine of New Orleans to build the New Orleans & Mississippi Valley Railroad from New Orleans to Baton Rouge, on the east side of the river, by January 1, 1883. The line is to be pushed through to Memphis as rapidly as possible.

MISCELLANEOUS.

NO MORE CONTRACTS.—Supervising Architect Hill states that no further contracts for work upon the government building at Hartford, Conn., will be made until the City Council disposes of the pending bill in reference to street lines.

ELEVATOR.—The contract for erecting the one million bushel elevator for the Union Elevator Company, in the lower part of the city of Peoria, has been awarded to Chicago parties. Work on the structure will begin within two weeks.

RELEASED CONTRACT.—It is rumored at Lafayette, Ind., that negotiations have been on foot some time looking to the release of the court-house contractors from their contract, leaving the thing on the hands of the county board of commissioners in its present incomplete condition.

NEW HAVEN IMPROVEMENTS.—This city will spend $10,000 this summer in improving East Rock park. There it talk of building a $60,000 trunk sewer.

THE NEW ORLEANS & MISSISSIPPI VALLEY RAILWAY from New Orleans to Baton Rouge, on the east side of the river, is to be completed by January 1, 1883.

BOUGHT OUT.—The Austin, Tex., capitol syndicate have bought out Matthew Schnell, the original contractor, for $15,500, with the approval of the capitol board. At a meeting of the capitol board, the old board of commissioners and the architect, Mr. Duhamel, were re-elected, and Mr. J. T. Dickerson, of Houston, was elected clerk of the board of commissioners.

TEXAS RAILROAD NEWS.—Nacogdoches *News*, May 4: The Bremond Railroad is progressing finely. The grade is all complete up to the Angelina river, and from Nacogdoches, south, the grade is about finished without an interval for 6 miles. Three or 4 miles work will complete the grading to town.

VICTORIA *Advocate*, May 6: We learn from Mr. Johnston I. C. Thomson, just returned from the West, where he left the New York, Texas & Mexican Railroad engineering corps about 90 miles from Brownville, that the line is being pushed with all possible dispatch to that city, which they hope to reach in about five weeks. The men all enjoyed good health since leaving Victoria.

THE IRON TRADE.—PITTSBURGH, May 17.—The reduction in card rates on iron in Philadelphia will have no effect on the agitation between the iron masters and workingmen here. Neither will there be any kick by the workingmen in Philadelphia against the reduction in wages which the reduction in the selling price of iron carries with it. When iron sells at $2\frac{7}{10}$ cents in Philadelphia bailers there get $5 per ton; when iron sells at $2\frac{6}{10}$ cents per pound bailers there get $4.75 per ton, which they will accept without murmur, because that is the contract and the policy also of the Amalgamated Association. When iron sells here at $2\frac{8}{10}$ cents bailers get $5.80, and when it sells at $2\frac{1}{2}$ cents here they get $5.50 per ton, which is the price paid for bailing now, though iron is really selling below $2\frac{1}{2}$ cents. The Philadelphia scale goes as low as 2 cents per pound, and the Pittsburgh scale only as low as $2\frac{1}{2}$ cents per pound as a basis. The workingmen here have investigated for themselves the condition of the iron market, and at their district meeting next Saturday will probably vote to recall the demand for an increase in the basis of the scales for bailers, rollers and engineers. The manufacturers will probably grant a few extras demanded by the men and then sign the scales which are in force here now.

THE COLLINS GRANITE COMPANY, of East Bluehill, Me., has contracts for cut granite aggregating over $60,000.

THE lowest bid for the new central depot in Rochester, N. Y., having been $150,000, the project is delayed. The Central engineers estimated $110,000 would build it.

SAN ANTONIO, TEX., is to have a brick yard.

ENGINEERS AND ENGINEERING IN OTHER LANDS.

(Specially translated and prepared from our Exchanges.)

A recent number of the Cologne *Gazette* has a long communication from its correspondent on the Isthmus. We give herewith a condensed translation: The number of workmen that have been employed since the beginning of the worke varied from 7,000 to 13,000. A rather remerkable circumstance, however, is that about 1,000 were always in hospital. West India negroes were "imported" to a considerable extent through the agency of two German houses, one in Panama, and the other in Kingston, Jamaica. From the latter-mentioned place, it would seem that negroes may be had *ad libitum* (a wink for contractors in Southern climes). One shilling (25 cents) is the usual daily wages of the negro in the West India Islands; but, it is said that they do not earn even this modest sum. However, bad as they are, 3,000 of them are now digging *at* the Canal. The native *mestites* are employed in the more congenial occupation of clearing the forests. These people have come even from Bolivar province, Columbia and from Venezuela. Chinese would seem not competent, and certainly past experience on the Panama Railroad would fortify this position, a great many of them even committed suicide; and one place has been baptized with the name of *Mata Chinos* (Chinese death). A rock, that with full tide would be washed by the ocean, was the favorite place for this manner of anticipating fate. A great many of those who preferred to stay in the world are now engaged in other and more profitable occupations than digging canals. A few, but very few, Europeans are engaged in manual work on the Canal. A dollar a day is the wages paid the ordinary workman, but one and a half dollars are now asked. Work begins at 7 a. m. The engineers employed have, of course, suffered, but not to such an extent as was supposed.

The Austrian civil engineers and draughtsmen are at last up in arms against that exceedingly kind disposition to forget that the "laborer is worthy of his hire." Architectural draughtsmen have especially suffered in Germany, as large factories would engage to furnish plans, etc., gratis.

The German Corporation of Civil Engineers who have their headquarters in Berlin have lately endeavored to stop this eternal cutting down of prices, by fixing a regular standard of prices, which would be so serviceable, even before the courts. The scale of fees that has been drawn up is as follows:

Consultations at home, orally or by letter	$2.50
Answers and simple information not under	1.25
Opinions in writing, preferably by agreement not under	2.50
Answers and simple information not under	1.25
Answers and simple works, with several hours activity (!) (*bei mehrstuendiger Thaetigkeit*) up to	10.00
Taxes, expert rates, traveling expenses, outside the cash expenses per day of eight hours at least from $10.00 to	15.00
For draughts, plans, estimates, inspection of works, a percentage according to sum of from ¼ of 1 per cent to 10 per cent	

These prices, it is consoling to know, at least to American engineers, are considered as *minima*, and are varied, upward, according to the capacity and reputation of the engineer.

The French and Germans are meditating great engineering projects, which, if carried out, will give employment to a great many engineers. These schemes are so vast in themselves that a separate consideration of them becomes absolutely necessary. The principal, the Nile irrigation scheme, the creation of a canal from Bordeaux to a point on the Mediterranean near Cette; the formation of a great interior sea to the south of Algeria and Tunis; the Dartmunds-Emshaven Canal, a project on the tapis for the last twenty-five years, to connect the great Westphalian manufacturing district with the ocean, and the much spoken-of railway through Asia Minor to Persia and India are the projects which are to employ the accumulated savings of Europe. The Nile project may be said to be one of the most fanciful, and would consist in creating vast irrigation works on the Upper Nile. Several engineers have already surveyed the country, and it is thought that M. de la Motte may eventually succeed in engaging European capital in the plan.

The Dartmund-Emshaven Canal will have sufficient depth to allow of vessels coming into the very heart of the coal and iron region of Westphalia. The width at bottom will be 16 meters, but no very definite plan seems as yet to have been adopted.

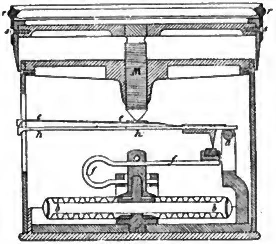


FIG. 1.—SECTION

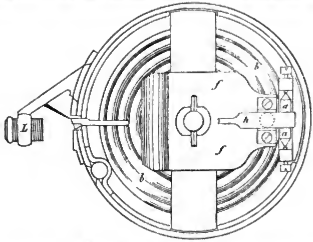


FIG. 2.—VIEW WITH CASE OFF.

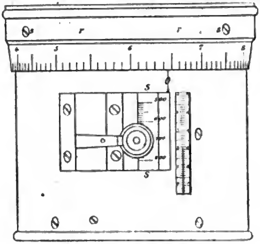


FIG. 3.—LONGITUDINAL VIEW.

At a late meeting of the French Civil Engineers a paper was read from M. Cotard on the general uses of water in furthering works for improving the navigability of rivers, etc. According to the author there is a great difference between torrential and quiet streams, although both may be met in the basin of a river. The studies with regard to the Seine were continued during twenty-five years until now a freshet or rise in the river is known two or three days in advance. He advanced the theory that the beds of the rivers present a series of pits or wells, separated by thresholds or borders, and that the natural action of water was to lower these separations. Dredging or narrowing the banks tended only to increase the rate of spead of a river but not to increase its depth, but the contrary. Between a system of dams and a lateral canal, he would prefer the latter, although many engineers are in favor of a mixed system. Raise the levels, and diminish the velocity, were the best means for permanently increasing depth.

The aneroids used in the Gothard tunnel works gave great satisfaction. They were known as the Goldschmid, and have been further improved by Hottinger, of Zurich. An order for 42 of the so-called leveling barometers was lately given by the Spanish government, and for four of the self-registering, aneroid barographs. A case or box, made of German silver, and almost void of air, is the general make. In the Goldschmid instruments there are no special detents in the cases, but the metal is so thick that the plates appear flat and parallel after the air has been pumped out. The pressure of the air is shown either on a lever system, to which it is transferred or directed by a micrometer screw, or finally, as in the Weilenmann instrument, by the combination of five or six cases, but these latter are difficult to carry, and have not fulfilled expectations and required several months to recover onequilibrium. Fig. 1 gives a sectional cut, natural size, of the Goldschmid aneroid for engineering purposes. The motion of the center of the case is here transferred by an arm to a lever and suitably increased. A detent is now used, which increases the delicacy without increase of size, the arm not only making the same movement as the center piece, but proportionately greater as the end of the lever arm in the instruments of Naudet and Reitz. Figs. 1, 2 and 3 show the improved leveling barometer. The air-exhausted case *b b* (Figs. 1 and 2) is made tense by the steel springs *f f*, and transmits its movements by this to the lever arm *h h*, rotating round the axis *a*. The verifying spring *e e* is screwed on the lever, and the contact of the micrometer screw *M*, with which the action of the case under changed air pressure is measured, and which could not be accurately enough determined by simply feeling with the hand, is produced by the coincidence of two lines that are drawn on the front of the lever *h h* and the verifying spring *e e*, and which can be accurately observed through the loop *L*.

CORRESPONDENCE.

TIDE BREAKERS.

Moon Island Office,
Atlantic, Mass., May 22, 1882.

Editor Engineering News:

I see by your paper of the 20th that 50 tide breakers were carried away at Portsmouth, etc. That is so. But I would like to add for your information that they have been replaced by new ones, and that the work is going on rapidly—100 cubic yards having been removed by J. A. Sylvester, contractor, the last month (since April 5).

And I wish to add that the work at Moon Island outlet sewer (by C. W. Parker and J. A. Sylvester, contractors) is rapidly progressing. The *gravel* filling for embankment is being put in by locomotive and cars, the gravel being dredged near by and dumped on to cars which run down to the dredger on trestle work, and from there drawn up to the embankment on which the sewer is being built. A new steam shovel is at work excavating for great reservoir at outer end of sewer, and the material is hauled up to embankment by another train of cars and placed upon the gravel filling. The stone masonry at both ends of sewer is being built, as also the brick work following up the stone masonry. Vessels are also employed bringing rip rap and ballast for the protection of both sides of the embankment, the length of which is about one mile.

Messrs. Parker & Sylvester are also constructing a large dock at South Boston Flats for the N. Y. & N. E. Railroad Co., the length of the dock when completed to be about 1,400 ft., and the work is going on rapidly.

I send you this without any advice, but know it will meet their approval.

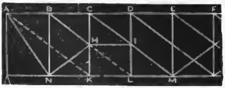
Jas. F. Cobb, Clerk,
With C. W. Parker & J. A. Sylvester,
Contractors.

REPLACING CHORD BARS.

New York, May 23, 1882.

Editor Engineering News:

I was surprised to learn from Mr. Loweth's last letter that I had not fully understood the details of his problem as given by him. Studying it more closely I believe I now fully comprehend it. He wished to replace the chord piece *K L*, by U rods passing around the piers from panel point *L* or *M* and the diagonals *A K* and *B L* and verticals *C K* and *D L* by a temporary truss *B C D E I H*, so to speak, supported at *B* and *E*, and wishes to know if these additions would make the modified truss self-supporting. With proper bracing in the temporary truss and point *N* supported by the U rods they will; otherwise not. The U rods from *M* or *L* to the piers will carry the entire strain between those points if made to support the panel point *N*. An examination of the figure will show this. If this is true, then the entire chord between *M* or *L* and the abutment could be removed without endangering the structure. If *N* is not supported by these rods then it must be supported in some other manner, as by *N H*, for example. There need be no question, therefore, about providing for the strain in the lower chord, consequently lack of stability can only arise if the temporary truss *B C D E I H* would not properly replace the web members which would be thrown out of action. An examination of the figure shows that the strain in the vertical *D I* is equal to that in the vertical *F O*, carried to *D* by diagonal *D O*, + the panel-load of truss in *D L*, and that in *C H* is equal to that in the vertical *E M*, carried to *C* by diagonal *C M*, + the panel-load of truss in *C K*. These are all the loads the temporary truss has to carry, and are those that the members which were to be removed would have to carry. From *B* the route of the strains on their way to the abutment is clear enough.



If the temporary truss can be made self-supporting, then the modified truss is self-supporting. If load in *D I* were equal to that in *C H* no bracing in temporary truss would be necessary for stability. A little study, however, will convince anybody that the load in *C H* is *always* greater than that in *D I*; our temporary truss, therefore, is *always* unsymmetrically loaded, and tends to sink in *C*, and this must be resisted: either by a tie, *D H*, or a strut, *C I*, of sufficient strength to equalize the loads in *C* and *D*. Insert such a piece, and all the strains in the truss are provided for while work in *K L* is progressing, except such as might arise from faulty construction of the temporary work.

This is only one method of solving the question. Others could be worked out that would be equally satisfactory. Another method which I used very successfully in replacing the lower chord of a Howe truss, would be to underpin the truss in the panel points *K* and *L*, and insert a counter-tie, *N C* while doing the work.

E. A. Rudiger.

METHOD OF REPLACING CHORD BARS.

St. Louis & San Francisco Railway Co.,
Porter, Ark., May 16, 1882.

Editor Engineering News:

The system of temporary trussing proposed by Mr. E. A. Rudiger in his letter on "Method of Replacing Chord Bars," Engineering News, May 13, is incomplete and incapable of transmitting all the strains which exist in the truss. At the lower ends of *BH* and *CI* there is no piece provided to take up the horizontal component of the forces in these members. The tie *HI*, shown on Mr. Rudiger's diagram, but not mentioned in the description, except as resisting the chord strain when the piece *NH* is inserted, will carry the horizontal component of *BH* to *I* where we have the four forces *CI*, *IM*, *HI* and *DI*. Then *DI* and *HI* can each be resolved into two components parallel and perpendicular to *CIM* respectively. *DI* being a strut and *HI* a tie, the two perpendicular components will act together, and it is necessary to introduce a tie, *IE*, in order to resist this component and make the truss complete and self-sustaining.

The chord strain may be taken up by the method used by Assistant Engineer, or as proposed by Mr. Rudiger. It may be well to notice that the strains in *BN*, *BH*, *HI*, *IM*, *IE* and *EM* are muchg reater when the latter method is used. For example, since the shear remains the same, the strain in *BH* is increased by the amount of that in *NH*. Whether the strains are dangerously increased depends, of course, entirely on the circumstances of the case.

Jos. A. Beaumont.

TABLE FOR ANGLES IN PLATE GIRDERS.

The Clarke Bridge Co.,
Baltimore, May 23, 1882.

Editor Engineering News:

In the last number of Engineering News, under Correspondence, "Table for Angles in Plate Girders," I observe that one of your readers would like to obtain a table for computing rapidly the net and gross sections of angles.

Having had a large number of plate girders, floor beams, etc., to proportion in sending out bids, I felt the necessity of such a table a few months ago, and got up the one I herewith inclose. It has proved to be of inestimable value to me in quickly proportioning the flanges of plate girders, floor beams, iron stringers, the top and bottom chord of latticed girders or any riveted structures where it is necessary to compute the net sections of angles, deducting as customary 2 rivets. The table inclosed saves a great deal of time and avoids errors which are likely to be committed by the most accurate and conscientious calculator. The table is so arranged that it needs no explanation, and I trust that it will be of use to Mr. J. D. F.,

TABLE SHOWING ALLOWABLE STRAIN ON ANGLES.

Taking tension 10,000 lbs. per sq. in. net section; compression, 8,000 lbs. per sq. in. gross section.

No.	Angles.	Area	Tension, deducting. 2 ⅝" rivets	2 ¾" rivets	2 ⅞" rivets	Compression gross
2	2½"×2"×¼"	2.10	17,900	17,300	16,600	16,800
"	" 5-16"	2.46	20,700	19,900	19,100	19,680
"	" ⅜"	2.90	24,300	23,400	22,400	23,200
2	2¾"×2½"×¼"	2.30	19,900	19,300	18,600	18,400
"	" 5-16"	2.94	25,500	24,700	23,900	23,520
"	" ⅜"	3.24	27,700	26,800	25,800	25,920
"	" 7-16"	3.80	32,500	31,400	30,300	30,400
2	2¾"×2¾"×¼"	2.42	21,100	20,500	19,800	19,360
"	" 5-16"	3.14	27,500	26,700	25,900	25,120
"	" ⅜"	3.66	31,900	31,000	30,000	29,280
"	" 7-16"	4.08	35,300	34,200	33,100	32,640
2	3¼"×2¾"×5-16"	3.36	29,700	28,900	28,100	26,880
"	" ⅜"	3.86	33,900	33,000	32,000	30,880
"	" 7-16"	4.56	40,100	39,000	37,900	36,480
"	" ½"	5.34	47,200	45,900	44,700	42,720
2	3"×3"×5-16"	3.60	32,700	31,900	31,100	28,800
"	" ⅜"	4.20	37,300	36,400	35,400	33,600
"	" 7-16"	5.04	44,900	43,800	42,700	40,320
"	" ½"	5.52	49,000	47,700	46,500	44,160
"	" 9-16"	6.36	56,600	55,200	53,800	50,880
2	3½"×3½"×⅜"	4.86	43,900	43,000	42,000	38,880
"	" 7-16"	5.66	51,100	50,000	48,900	45,280
"	" ½"	6.62	60,000	58,700	57,500	52,960
"	" 9-16"	7.70	70,000	68,600	67,200	61,600
"	" ⅝"	8.88	81,000	79,400	77,900	71,040
2	4"×4"×7-16"	6.84	62,900	61,800	60,700	54,720
"	" ½"	7.56	69,400	68,100	66,900	60,480
"	" 9-16"	8.48	77,800	76,400	75,000	67,840
"	" ⅝"	9.20	84,200	82,600	81,100	73,600
2	6"×6"×7-16"	10.10	95,500	94,400	93,300	80,800
"	" ½"	11.60	109,800	108,500	107,300	92,800
"	" 9-16"	13.10	124,000	122,600	121,200	104,800
"	" ⅝"	14.60	138,200	136,600	135,100	116,800
"	" 11-16"	16.14	152,800	151,100	149,400	129,120
"	" ¾"	17.70	167,600	165,700	163,900	141,600
2	3"×2"×5-16"	2.70	23,100	22,300	21,500	21,600
"	" ⅜"	3.32	28,500	27,600	26,600	26,560
"	" 7-16"	3.92	33,700	32,600	31,500	31,360
"	" ½"	4.54	39,200	37,900	36,700	36,320
2	3"×2½"×5-16	3.28	28,900	28,100	27,300	26,240
"	" ⅜"	3.88	34,100	33,200	32,200	31,040
"	" 7-16"	4.56	40,100	39,000	37,900	36,480
"	" ½"	5.16	45,100	44,100	42,900	41,280
2	4"×3"×⅜"	5.16	46,900	46,000	45,000	41,280
"	" 7-16"	5.74	51,900	50,800	49,700	45,920
"	" ½"	6.48	58,600	57,300	56,100	51,840
"	" 9-16"	7.36	66,600	65,200	63,800	58,880
"	" ⅝"	8.08	73,000	71,400	69,900	64,640
2	3½"×3"×⅜"	4.36	38,900	37,900	37,000	34,880
"	" 7-16"	5.16	46,100	45,000	43,900	41,280
"	" ½"	5.98	53,600	52,300	51,100	47,840
"	" 9-16"	6.80	61,000	59,600	58,200	54,400
"	" ⅝"	7.62	68,400	66,800	65,300	60,960
2	4"×3½"×⅜"	5.26	47,900	47,000	46,000	42,080
"	" 7-16"	6.18	56,300	55,200	54,100	49,440
"	" ½"	7.20	65,800	64,500	63,300	57,600
"	" 9-16"	7.90	72,000	70,600	69,200	63,200
"	" ⅝"	8.76	79,800	78,200	76,700	70,080
2	4½"×3"×⅜"	5.20	47,300	46,400	45,400	41,600
"	" 7-16"	6.34	57,900	56,800	55,700	50,720
"	" ½"	7.24	66,200	64,900	63,700	57,920
"	" 9-16"	7.98	72,800	71,400	70,000	63,840
"	" ⅝"	8.86	80,800	79,200	77,700	70,880
2	5"×3½"×⅜"	6.08	56,100	55,200	54,200	48,640
"	" 7-16"	7.16	66,100	65,000	63,900	57,280
"	" ½"	8.22	76,000	74,700	73,500	65,760
"	" 9-16"	9.26	85,600	84,200	82,800	74,080
"	" ⅝"	10.44	95,600	94,100	92,500	82,720
2	6"×4"×½"	9.56	89,400	88,100	86,900	76,480
"	" 9-16"	10.68	99,800	98,400	97,000	85,440
"	" ⅝"	11.82	110,400	108,800	107,300	94,560
"	" 11-16"	12.90	120,400	118,700	117,000	103,200
"	" ¾"	14.10	131,600	129,700	127,800	112,800

C. E., and I beg of you, if you think it advisable, to publish it as it may be of great use to those in the profession who are concerned in bridge designing.

F. E. Eilshemins, C. E.

RAILROADING ON THE PACIFIC SLOPE, ETC.

Boston, May 28, 1882.

Editor Engineering News:

In the selected article, "Railroading on the Pacific Slope," in your last issue, some of the figures seem to be rather carelessly stated. Notice the following: "In two miles on the division above Emory there are no less than 600 trestles and bridges," or about 6 to 100 ft. on an average.

In the scheme for standard time, why would it not be well to denote all the hours by letters, to distinguish from local time, A being for midnight, M for noon, etc.?

The sections for angles J. D. F. will find in "Carnegie" and some other handbooks. The area in sq. in. is equal to one-tenth the weight of a yard of iron. For special forms the planimeter is a rapid means of finding the area.

"Builders' Quantities" are very convenient in estimating. Most of those given under that head in your last issue are somewhat in excess, as they should be. We should like to see more of such data given.

E. P. A.

CALCULATING "OVER-HAUL."

Newburgh, N. Y., May 24.

Editor Engineering News:

As a resident engineer I have been under different chief and division engineers, and find that no two ever calculate "*over-haul*" the same way. At present the specifications read as follows:

"Provided the '*average haul*' of the material so transported does not exceed one thousand (1,000') feet, and beyond that distance ($-c.) per cubic yard per one hundred (100') feet will be allowed and paid for such *extra haul*."

I would like information concerning the question of calculating over-haul, and knowing of no other one more likely to quote authority than yourself, I have taken the liberty of writing to you asking for your assistance.

G. A. M.

[We will be pleased to publish the methods in use by such of our readers as will favor us with the same.—Ed. Engineering News.]

ADJUSTMENT OF GRADES TO CURVES.

Chief Engineer's Office,
Tionesta Valley Railroad,
Sheffield, Pa., May 17, 1882.

Editor Engineering News:

In reviewing the good things in your valuable paper, as I make it a practice to do, I find a very interesting article on Adjustment of Grades to Curves, in Volume 9, No. 9.

I entirely agree with the gentleman from Glendive, as I also do with Hensenger von Waldegg, that the gauge has very little to do with curve resistance in standard as compared with other gauge of roads.

Many argue that the difference is as the squares of the gauge. I have ever failed to find it so. If my memory serves me right, I have found it to be about as follows:

The *relative* resistance due to *gauge* is *inversely* as the radius, minus *twice* the *gauge*, *squared*. For example, in a 4° curve on standard (4 ft. 8½ in.) gauge and narrow (3 ft.) gauge we should have the resistance *inversely* as $(1432.69 \text{ ft.}-9.42 \text{ ft.})^2$ is to $(1432.69 \text{ ft.}-6 \text{ ft.})^2$, which you will perceive is very little different.

When called to take charge of the above road my predecessor had made it a rule to use an "equation" of 0.05 of a foot to the degree for stations of 100 ft. This "equation" was a constant and applied to a 1° curve alike with a 20° curve, not being increased as the radius became shorter. In finishing up the work begun by him I of course used his "equation," though it was erroneous.

While I was employed by the Denver & Rio Grande Railway Company I received orders to use 0.04 of a foot to the degree, and afterward received new orders and instructed to use 0.05 per degree of total curvature for stations of 100 ft. length.

Several years ago I made some investigations on the resistance due to curvature and adjusting grades to curves to make resistance maximum on the tangents and equal on all degrees of curvature, that is, lessening grade on the curves. I found the resistance to be greater per degree as the radius became shorter, and compiled a table of "adjustments" from 1° to 20° of total curvature per station of 100 ft. My results do not agree with either of the tables given by Brother Glahn, although they may be nearer the truth than mine; yet I have noticed where I have used the following table that an engine was always able to take any train through to destination if it could start it on either curves or tangent on maximum grade. This in view, I think it may be safely used, and if of any use to fellow engineers, I shall feel doubly repaid for all the labor it has cost me in its computation

	Per station of 100 ft. Foot.		Per station of 100 ft. Foot.		Per station of 100 ft. Foot.
1°	0.039	8°	0.348	15°	0.772
2°	0.079	9°	0.400	16°	0.845
3°	0.120	10°	0.453	17°	0.922
4°	0.162	11°	0.513	18°	1.003
5°	0.206	12°	0.573	19°	1.089
6°	0.251	13°	0.636	20°	1.180
7°	0.298	14°	0.702		

F. F. Whittekin,
Chief Engineer T. V. R. R.

◆

THE NEW CORLISS ENGINE AND PUMP AT PETTACONSETT, PROVIDENCE, R. I.

This new engine, which was built for the Boston improved sewerage, but which the city of Boston would not accept, was sold to the city of Providence to replace the Cornish engine at the Pettaconsett pumping station of the Providence Waterworks. The price is $100,000, and the contract called for a pumping capacity of 7,000,000 gallons per 24 hours. The official trial of the machinery was commenced on the 22d, to be continued six days. The fly-wheel, 25 ft. in diameter, makes 36 revolutions per minute in pumping at the rate of 9,000,000 gallons, and at the trial the speed was run up to 50 revolutions per minute, at which water was pumped at the rate of 12,588,643 gallons per 24 hours.

The following is a

DESCRIPTION OF STATION AND ENGINE.

The pumping station is located on the banks of the Pawtuxet River, about 200 ft. from the Cornish engine house.

BUILDINGS.

The buildings are of brick with granite foundations. The engine is 38 ft. by 60 ft., outside, and 36 ft. high above grade. The windows are 17 ft. 10 in. high by 5 ft. 8 in. wide. The boiler house is of the same height as the engine room—80 ft. by 48 ft. 8 in., and the walls of both buildings are 2 ft. thick. The chimney is 86 ft. high above grade, having a flue 4 ft. square. As the grade is fixed at 16 ft. above ordinary high water in the Pawtuxet River, there is a basement 10 ft. 8 in. deep, lighted by two windows opening toward the river, which are provided with iron shutters for use in case of extraordinary freshet.

PUMP WELL.

The pump well is 15 ft. 8 in. by 17 ft. 8 in., and has a heavy floor of ribbed cast iron, the bottom of which is 2 ft. 6 in. below the bed of the river.

CONDUIT.

The pump well is connected with the river by a cast-iron conduit 35 ft. in length 5 ft. in width and 7 ft. in height, provided with a gate operated by hydraulic pressure. The outer end of the conduit is formed to receive a movable grating convenient of access and having bars one inch apart. From the bottom of the iron floor of the well up to the engine room floor is 24 ft. 10 in. From the same point to the ceiling of the room is 50 ft. 4 in., and to the top of the chimney 109 ft. 7½ in. The engine room is ceiled with wood, which forms a panel covering the entire space occupied by the machinery; the remaining portion of the ceiling and the side-walls are plastered with two coats of brown mortar, finished in soapstone of a gray tint. In the ceiling directly over the heavy parts of the machinery are located 10 eye-bolts, each capable of sustaining 15 tons weight.

STAIRCASES.

All parts of the building and the galleries for walking-beams are made accessible by iron staircases provided with hand-rails of polished brass.

EXCAVATIONS.

In clearing the ground and preparing for the foundations of this work more than 5,000 cubic yards of earth had to be removed to a distance of one-quarter of a mile. When the level of the river was reached a bed of quicksand was encountered, extending to a depth unknown. To insure the necessary solidity for sustaining the heavy weight to be held up by the foundations, recourse was had to the use of 1,394 wheelbarrow loads of cobble stones and 651 of gravel, driven into the sand by means of a spherical cast iron hammer, 32 in. in diameter, weighing upward of 4,200 lbs., dropped from heights varying from 30 ft. to 40 ft. Four thousand three hundred and ten blows of this hammer were applied in preparing these foundations.

MATERIALS USED IN CONSTRUCTION.

241,022 bricks.
600 cords of building stone.
310 barrels of lime.
628 barrels cement.
110,000 lbs. iron (exclusive of machinery).
67,140 ft. hard pine and other lumber.

ENGINE.

The machinery consists of two beam engines, working on the compound principle, coupled together by a crank-shaft carrying a fly wheel 25 ft. in diameter, weighing 31 tons.

The high-pressure cylinder, 18 in. in diameter, takes steam direct from the boilers, 125 pounds pressure, and exhausts into a receiver placed between the engines. The low-pressure cylinder, 36 in. in diameter, takes steam from the receiver and exhausts into the condenser. Both cylinders are steam jacketed, and have the same length of stroke, 8 ft.

The valve gear for both engines includes cut-off, variable at pleasure by hand, and also regulated by a governor, and embodies improvements in construction which were first brought out and exhibited on the "Centennial engine," at Philadelphia in 1876.

PUMPS.

The pumps, 4 in number, are of the plunger type, the plungers for which are each 18 in. in diameter and have 8 ft. stroke. Each pump chamber contains 192 valves, 96 for the suction and 96 for the delivery. The aggregate area of 96 valves is largely in excess of the area of a plunger.

BOILERS.

There are 4 boilers of the upright "Corliss" pattern, generally rated at 100 horse-power each; but when pumping at the rate of 10,500,000 gallons in 24 hours, only 3 of the boilers are used—although the power required is 375 horse-power (or 125 horse-power for each boiler.

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SPECIFICATIONS.

There is no subject more important to contractors and constructors in every branch of business than that referring to specifications; and yet these latter are only too often regarded as dead letters by those for whose guidance they are supposed to be drawn. As an illustration of this we may say that it has come to our knowledge that managers of large iron works have, on the receipt of specifications, taken it for granted that there was nothing special in them.

The general fault in specifications is that conditions are imposed which are either illegal or impossible to be insisted upon, and in respect to the illegality, we would call attention to the power given (nominally) to an engineer or architect to decide disputes which really can only be determined in law courts, or in the Chancery Division of the Supreme Court of Judicature. Arbitration, as a rule, is unsatisfactory, as much may be suppressed before an arbitrator which would be given in evidence in the ordinary law courts.

A good instance of the crude way in which specifications are drawn may be found in the fact that a specification for a line of railway seldom includes instructions for the carrying out of oblique arches, this omission being probably due to the fact that such specifications are drawn by unlettered clerks instead of being properly prepared by competent engineers or architects. The results accruing from such work being entrusted to people of the class to which we have referred are not unfrequently sufficiently ridiculous. A really amusing instance of this came under our notice a few years since, where the specification for a line of railway on which all the bridges were built of *brick* was copied from that of a line on which the bridge abutments were constructed of *stone*, so that the specification contained several pages referring to the execution of rubble masonry, face dressing and Ashlar, and but five lines referring to brickwork, if required.

In clauses referring to ironwork special care should be taken to put no over stringent restrictions upon the contractor. In designing the ironwork the engineer should first ascertain the strength of the iron which will be used in the construction of his work, and this he can almost invariably do. In the construction of girders we have to regard not only the ultimate strength of the iron, but also its elasticity; very stiff wrought iron is not to be relied upon, on account of its liability to snap; in fact, iron of such a character is less reliable than cast iron.

Generally speaking, there is need for more care in the matter of specifications on both the architect's or engineer's part and the contractor's. The former, while so forming his clauses as to leave no loophole for "scamping," should take care not to be over harsh. Some specifications we have seen which no contractor in his senses would think of attempting to work to. Others again, like the one mentioned above, have been so slipshod in their language and general bearing as to permit of almost any construction being put upon them. These latter are fruitful causes of lawsuits, and encourage that bane of the contract system, the "scamper," than whom we know no one more objectionable. A happy medium between these two extremes is what is wanted, with a due attention to any exceptional features that the work may happen to present.

It would be impossible to deal with such a many-headed question as this in a few short lines; we merely wish to keep the subject before our readers, pointing out from time to time, as opportunity occurs, anything that may be obviously wrong. We would take occasion to again remark that this matter will never receive the united attention which it ought until we have a central society of contractors, where questions of this kind can be dealt with by contractors as a body. When we have such a society, then we shall be within a measurable distance of well-drawn and equitable specifications.—*London Contract Journal, May* 10.

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THE KEELY MOTOR SUIT.

Philadelphia, May 24.—John W. Keely to-day filed his answer to the equity suit against him by the stockholders of the Keely Motor Company. The answer, which is sworn to, substantially admits the truth of the formal portions of the complainant's bill concerning the contract, etc. Keely adds that although, owing to certain abstruse difficulties by reason of the nature and qualities of the said force, he has thus far failed in his efforts to bring the said inventions and discoveries into any practicable use, or to arrive at the utility required by the law, he believes he will ultimately succeed.

ENGINEERING NEWS

AND

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GEO. H. FROST..............PROPRIETOR.

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S. D. V. BURR. ....ASSOCIATE EDITOR.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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THE MISSISSIPPI JETTIES.—Admiral Daniel Ammen, U. S. N., in the N. Y. *Herald* of the 22d, criticises the condition of the jetties and predicts the closing of the South Pass by the accumulating deposits being carried to the sea end of the jetties and there forming a bar.

EMPLOYER AND EMPLOYÉ.—Employers in many of the large cities are forming unions to resist the demands of the trade and labor leagues. It is to be regretted that two interests, mutually dependent upon each other, and of vital importance to not only their immediate section but to the whole country, should be compelled to unite their forces in order to successfully combat each other. It requires no gift of prophesy to foretell which will yield first, the union of laborers with no money, or the union of capitalists with practically unlimited wealth and boundless resources.

NEW PUBLICATIONS.

Report of LIEUT.-COL. HENRY L. ABBOTT, U. S. Engineers, upon Submarine Mines for the Defense of Harbors of the U. S. Professional Papers, Corps of Engineers, U. S. A.

A large quarto, under the above title, has issued from the Government press, at Washington, D. C., with illustrations of the various apparatus used, and effects produced, in experimenting with torpedoes at the Government Station, Willett's Point, East River. The work is divided into three chapters. The first, on the effects of explosions of torpedoes with varying charges of different explosive compounds, is interesting as descriptive of the phenomena attending subaqueous explosions, and which are so rarely to be witnessed on a large scale as to render these descriptions, embracing experiments as conducted in Europe on full-sized ships, as well as the explosions in the East River channel, commencing in 1869 at Willett's Point, and continuing until the present time, with illustrations, of great professional interest; but aside from the curious anomalies attending these explosions, as witnessed from the shore, which are seized on the instant by a number of cameras arranged to receive their impressions at intervals of fractions of seconds, the one from the other, and so giving, as it were, a moving picture of the explosive effects, the subject is without much practical interest to the civilian, as not likely to come within the field of his own operations.

A very simple expression, as the result of the experiments, has been arrived at for the extreme destructive range of torpedo effects against shipping in varying depths of water, upon the supposition that dynamite No. 1 (which explosive compound has been selected from a large number as giving the best results for this service) is used. By the following formula it is computed that if a vessel of war of the first class lies at or within the distance Δ she will be destroyed; if beyond that distance she will escape rupture of the hull:

$$\Delta = \frac{\sqrt[2.1]{\left(\delta + \varepsilon\right)c}}{8}$$

c. Weight of dynamite in pounds.

ε. Constant derived from experiment.

Δ. Distance in feet from object.

δ. The angle with the vertical passing through the centre of the charge made by a line drawn from that point to the surface exposed to shock, reckoned from the nadir in degrees. The submergence being not less than 3 or 4 ft. for each 100 lbs. weight of charge.

We quote, in reference to this formula: "Upon the supposition that the strength of the hulls of ships of war should be increased, a corresponding change in the constant 8 would indicate the new requirement. Suppose that some new explosive compound should prove to be better suited to the work than dynamite No. 1, a new value for the constant ε is all that becomes necessary. It will, therefore, be comparatively easy hereafter to keep pace with modern progress, but it must not be forgotten that there will be need of constant vigilance and of systematic research."

Chapters No. 2 and 3, on the contrary, while treating of the various forms of electrical progress, and apparatus for igniting the charge, having reference to their uses in connection with the torpedo service mainly, are of value to the civil engineer as applicable also to submarine blasting or excavation of any kind, where indeed this form of fuse and igniting apparatus are alone to be relied upon, while the torpedo service under any emergency will probably be left to the highly trained special government officers. Submarine mining and excavations, such as opening the channel at Hell Gate and similar undertakings, will properly fall under the head of Civil Construction, and the substance of these two chapters become of equal interest to the civil as to the military engineer, and a sketch of their contents will be of interest.

Chapter II. treats exclusively of the various forms of electrical fuses. This is the delicate point involved in submarine blasting, and samples of every variety of fuse obtainable in this country or in Europe have been experimented upon, the laws of their ignition analyzed, and the resulting formulæ experimentally verified. It will be recollected that whatever may be the charge used in submarine blasting, whether it be a torpedo which may remain for months under water before being called into use, or a submerged tunnel through rock, the fuse by means of which the charge is to be exploded, and which must be in contact with it, must be equally preserved against deterioration by moisture or any other means whereby its sensitiveness to action by an electrical current can be impaired. All these forms of fuses are based upon the property possessed by a Voltaic current of heating any poor conductor introduced into the circuit. Every electrical fuse should have: *First*, two insulated conductors for conveying the current. *Second*, a plug to receive and firmly hold an end of each near to but not touching the other. *Third*, a small priming suitably arranged for ignition at this point, and *Fourth*, a metallic cap containing a detonating charge, usually of fulminating mercury. The result of most extended experiments at Willett's Point in reference to this subject is thus stated:

"The low tension variety of fuse is used with strong electrical currents of low potential; the high tension variety with condensed sparks capable of jumping a sensible air space; and the medium tension, especially designed for magneto-electric machines, which generate electricity characterized by a potential higher than the former and less than the latter. It does not follow, however, that a given variety of fuse can only be ignited by a particular kind of electrical generator; but as a rule, each of the three classes of generators should be provided with a fuse specially adapted to it. The conditions common to all fuses, however, are stated as follows:

"1. The insulated conductors should be tough and of low electrical resistance. Lake Superior copper wire, No. 20, B. W. G., of two unequal lengths (5 and 7 in.) have been adopted. The insulation must be proof against deterioration from age, a condition which excludes gutta percha and india rubber; it is well fulfilled by a closely woven wrapping of cotton thread coated with paraffine, or with beeswax, resin and tar boiled together; the free ends bared for about 1¼ in."

"II. The plug must be a non-conductor of electricity, not liable to detoriate with time and exposure to damp air, nor to corrode the copper wires. Beech wood, kiln dried and coated thickly on the outside with Japan wax, well fulfills these conditions. The shape must be such as to render any contact between the wires impossible, and to clamp them so firmly that no accidental strain on the free ends can disturb their internal adjustment. The following form is used, and may be understood without a diagram:

"The plug consists of three parts. 1st, a cylinder, ¼ in. in diameter and 0.7 in. long, grooved longitudinally on its opposite sides to secure the wires. Entirely round the middle is a cut, .05 in. deep and .15 in. wide. The wires with their wrapping of cotton are each pressed into one-half of the longitudinal grooves until they reach the cut; they are then both bent sharply to the left, nearly at right angles, and are led through this cut until they have passed half round the cylinder, when they are again bent at right angles and pressed into the other half of the longitudinal grooves. Then each wire leaves the plug in the opposite groove from which it entered, and at no point can they come in contact with each other. The inside ends of the wire are then bared, scraped, cut to the proper length (about .1 of an inch), and prepared according to the class to which the fuse belongs. 2d, of a hollow cylindrical cap with a stout shoulder at one end having a smaller hole for the passage of the free ends of the insulated wires. This cap is made to closely fit the solid cylinder, and the latter smeared with glue is forced into it until the end abuts against the shoulder having a small chamber round the bridge (by this term the short thin metallic connection between the wires in the low tension fuse is meant) to receive the priming. 3d, of a paper disk held in position by a drop of collodion, to close the latter. These several parts are turned by machinery to fit each other accurately, and forms a solid, strong and perfect protection to the bridge and priming.

"III. The detonating cap is made by punching a disk of stout sheet copper into a cylindrical form fitting the plug closely. The bottom is solid and contains 20 grains of fulminating mercury, held in place by a paper disk secured by a drop of collodion. This charge, which, added to the priming amounts to about 24 grains, is found by experiment to be amply sufficient to detonate dynamite in loose powder, either soft or frozen. The cap is 1 in. long and 0.4 in. in diameter, and entirely encases the chamber of the plug, and secured to it, by indenting it by pressure near the top into the wood. The fuse thus formed is 1¼ in. long and 0.4 in. in diameter, and when completed is dipped into melted Japan wax, giving a waterproof coating to the whole."

The different kinds of fuses, as also the metal used for conducting the electricity between the insulated wires, and its dimensions, as also the waterproof material, and every part and parcel of which the fuse is made, or of which its filling is composed, has been the subject of extended experiments and investigations before determining the proportions of ingredients, and provision is made for determining by actual tests in all cases in advance the character of the fuse and its certainty of action and its sensitiveness, and all these points are put into practical shape by formulæ ex pressive of the condition under which given results may be anticipated.

To illustrate the necessity of this in the case of the ignition of high tension and medium tension fuses. On one occasion at Willett's Point fifty of these fuses, connected in series, were hung upon nails driven in the sides of a wooden shed, and the induction of an ordinary thunder-cloud caused the explosion of *five* of them—every fuse which touched a nail. An ebonite comb passed a few times through the hair of a child holding one of the terminal wires, the other being insulated in the air, generates a current sufficient to fire the priming.

The experiments which are given in detail in the appendices, specifying the character of the fuse as well as the charge, and the apparatus for ignition, whether frictional, dynamo-electric, or voltaic, the principles of which, and the relative advantages, are all sufficiently enlarged upon, altogether form a mine of information to the civil engineer engaged in submarine blasting, and the extent of which can scarcely be realized unless by consulting the pages of this Report, together with the Torpedo Musuem at Willett's Point, which we infer is open to such examination. This inference rests upon the fact that much of Gen. Abbott's labor has been devoted to investigations and experiments which are for obvious reasons witheld from the public; but what is given in this Report and its reference to the musuem of apparatus at Willett's Point has been published with a view to the dissemination of information of value to the public interests in prosecuting our great internal improvements, and which can be sought for to advantage at no other source.

SECONDARY BATTERIES.

At the beginning of the present century it was known that the wires from a pile, the current of which had been used to decompose water, possessed the peculiar property, after having been detached, of giving off an electric current, considerable in power, but brief in duration, and which early received the name of "secondary current." These currents became the special study of the French physicist, M. Gaston Planté, and in 1859 he began a thorough investigation into the effects produced by voltameters of different metals and different excitants. As a result of his labors he found that lead plates immersed in dilute sulphuric acid would yield a greater amount of dynamical electricity than any other combination. Here we have the more important steps leading to the secondary battery, or, as it is sometimes called, the accumulating or storing battery, and upon which is now directed the combined energy of the scientific world.

The secondary battery of M. Planté, as constructed by him in 1860, consisted of two broad and long strips of sheet lead, placed one upon the other, with an intervening layer of coarse cloth, and then rolled into a spiral. From each sheet projected a thin strip to form the electrodes. The roll thus formed was placed in a jar filled with acidulated water in the proportion of one part sulphuric acid to ten parts water, and as this ratio has been used in all the batteries hereafter described we will not mention the parts again. The cloth in this arrangement was a great disadvantage, as it had no endurance when placed in the acid, and as it presented an additional interior resistance; as an improvement the plates of lead were placed parallel to each other and kept apart by rods, the whole being set in a rectangular vessel and presenting the appearance of a zinc-copper battery, as constructed a long time ago. This, although giving quite good results, was not satisfactory for continued use, as the chemical decomposition resulting on the lead surfaces had a tendency to warp them and thus produce unexpected contacts, destroying the efficiency of the apparatus.

The Planté battery as now made is formed of two sheets of lead rolled upon each other, and separated by narrow India rubber strips, which have the advantage of remaining unaffected by the acid. When being constructed the plates of lead are placed one upon the other, the separating strips between, and the whole rolled upon a small cylinder of either metal or wood. In order to insure a permanent insulation it would be well to lay two of the strips near and parallel to the edges that will form the end of the roll, and two strips transversely. The electrodes are placed at opposite sides of each strip, so that when finished one projects from the center of the roll and the other from circumference. We now come to the most important operation connected with the construction of this battery, namely, the formation.

An electric current from a Bunsen or other battery, or if possible from a dynamo machine producing currents in the same direction, is made to pass through the element. A decomposition depending in rapidity upon the strength of the current is commenced, oxygen being liberated at one plate and hydrogen from the other. If the exciting current be detached and the two sheets connected, a current (called secondary) will be produced. This action is owing to the presence of the oxygen, which leaves its own plate and attacks and oxidizes the other; and from this it will be readily perceived that the strength and duration of the battery depends upon the superficial area of the plates and of the power and period in action of the primary current. In order to prepare the cell for the reception, or accumulation as it is generally termed, of electricity, the course of the current is now changed, when the chemical actions occur at the opposite plates, and in course of time the surfaces are altered, one being covered with a spongy mass of reduced lead, and the other with peroxide of lead, when the cell is complete and ready for electrical accumulation. In order to permit of crystallization, a delay of five or six days is allowed between the changing of the currents. The capacity or power of the battery depends upon the amount of peroxide of lead to be reduced and the amount of lead to be oxidized. Of course the deeper the charge is made to enter the sheets the greater will be the final result, and consequently the first current should be powerful.

FAURE.

M. Faure reasoned that if the chemical changes which take place in the Planté battery could be produced by mechanical means, the ultimate strength would be increased, and the time required for making, and therefore the cost, would be most materially lessened. He also added some further improvements tending to increase the actual surface exposed to action without adding much to the size of the plates.

In constructing a cell after his plan a sheet of lead is cut the required size and perforated with a number of holes. A layer of red lead, mixed with water, slightly acidulated with sulphuric acid, is spread evenly over this plate; first one side being prepared and covered with a protecting sheet of parchment, and then the other. A cloth sack is now placed around the plate so as to completely encompass it, with the exception of one corner, which forms an electrode. The positive and negative plates are constructed in the same manner. The plates are then arranged, parallel to each other, in a box, and the exposed corners of alternate plates connected, so that there are but two electrodes—positive and negative—leading from each cell. Acidulated water, same as in the Planté, is now poured into the box until the plates are submerged about half of an inch. The cell is now completed, so far as its mechanical construction is concerned.

Several cells are placed in the same circuit of a powerful dynamo machine—not alternating—and left until the red lead on the positive* element has been converted into peroxide of lead, and the red lead on the other element into a spongy mass of reduced lead. The battery when ready for use may be charged with electricity, after which it is used in the same manner as the ordinary galvanic battery.

Two weeks since the steamship Labrador arrived at this port from France with several of the Faure batteries on board which had been used during the entire voyage to light the vessel. From a report published in one of the New York papers, and purporting to come from the engineer who had charge during the voyage, we learn that "A Faure battery will last about 400 hours, delivering one weber per hour of current, with an electro motive force of two volts. It thus requires two secondary piles to run an Edison lamp, but these two piles will run such a lamp steadily 400 hours without replenishing the charge."

THE PANAMA CANAL.

Ever since the inception of this project the items purporting to be of a reliable character have been tinged with the local bias of the papers publishing them, or with the personal interests of the individuals giving them. To a large extent the western slope is interested in the success of the project, inasmuch as it might enable shippers to enter into more close competition with the railroads, and as a consequence we receive glowing accounts and descriptions of the progress of the work. Dispatches from "the seat of war" vary according to the political feelings of the sender. The English and French papers publish such information as M. De Lesseps sees fit to give them.

The New York *Tribune* publishes an interview between its Paris correspondent and M. Le Lesseps. This states that on the 30th ult. Messrs. Hume, Slaven & Co., of San Francisco, signed a contract to excavate 6,000,000 cubic meters at the Atlantic end of the canal, work to commence within six months after the signing. The great projector is reported as saying: "We are pushing things, and we have good reason to hope that the great work will be completed in 1888 or 1889, for the difficulties were not so great as were anticipated." Three hundred millions of francs of stock is held by Frenchmen, and it is quoted (by M. De Lesseps) as being 40 francs above par. Illustrating again the adage about crows, and which crow was deepest dyed, M. De Lesseps has a few words to say regarding the projected routes, as follows:

"The Eads ship railroad is before the public. Capt. Eads is a great engineer, and I have the highest respect for his opinion on subjects which pertain to engineering; but when it comes to sending ships across the isthmus by leaving them in their natural element or by carrying them over in mid air, I think I am correct in saying that the vast majority of ship-owners will prefer the former method. The Nicaraugua canal, the Eads railroad, et al., will, if they are ever made, only be of advantage to my canal, for commerce will always prefer to keep ships in the open water to sending them up in the air or hampering them with locks. I admire Admiral Ammen, but I don't take his stocks." Here we have a statement purporting to come direct from the most interested party, and it presents a most encouraging outlook for the undertaking.

OUT OF PRINT.

"Latham's Sanitary Engineering," American edition, is *out of print*, and no more orders for the cheap copy will be taken. On the strength of our advertisement, lately published, *every copy was sold*, and unless we can pick up a stray copy here and there, we can fill no further orders at less than $12, for which we will send the English edition. We cannot even fill an order for the $3 copy. We regret having been obliged to return the money for a number of copies sold this week, but it was unavoidable.

This book, the first of any importance and the most complete as yet that has been published on the subject of sewerage, has fulfilled a good purpose. The price of the English edition amounted to almost a practical prohibition of its extensive introduction into the libraries of American engineers, who could ill afford to spend from their small salaries so large a sum for a single volume. Our publication of it therefore as a supplement to ENGINEERING NEWS without extra charge was re-

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[*] Which is the positive element is determined by the direction of the current from the dynamo.

ceived with universal approval by our readers, and it gave to our subscription list a very satisfactory increase, an increase which thereafter became permanent. What the benefits arising from the distribution of several thousand copies of such a book may be we leave for our readers to infer from their personal experience.

Another notable book which we published, "Humber's Water Supply," is also out of print, and we have sold every copy but one unbound one, now in our possession, but which is also for sale at $12. This reprint is, we claim, the largest undertaking in scientific book publishing in the history of the trade in America. A $60 book was reproduced, full size and almost equal in every respect to the original English work, and placed on the market at $10 per copy. Van Nostrand has a few copies of the bound volume remaining unsold, the price of which is $20. When these are disposed of the price will go back to original figures, or nearly so.

We are now offering such numbers of the well-known Weale's Series as are on our shelves at *half price* for a short time only, as when the sale becomes slow we will sell the balance of the stock to the second-hand book dealers at the best attainable prices. We have also the remaining copies of Greene's Bridge Trusses, published in 1877, and which was one of the most popular and best selling books on the subject of bridges ever published. We offer it at 60 *cents*, post-paid to any address. The price of the new edition is $2.50. The 60-cent book is the best in bridge literature that can be bought anywhere to-day at the price. The Annales des Ponts et Chausées, bound in 4 vols., for 1878, for $5; for 1880, complete but unbound, $3; for 1881, less Nos. 9 and 11, for $2. The subscription price in Paris is 33 francs. A set of the Transactions of American Institute of Mining Engineers, 1874 to 1881, 7 vols., complete and bound in stiff paper, uncut, is for sale at $3 per volume; Journal of Franklin Institute, 1867 to 1872, 5½ years, or 11 vols., elegantly bound, for $20; for 1876 and 1877, complete in 2 vols., at $2.50 each. There probably will not soon be as favorable opportunities for buying these valuable books at the same low figures, and therefore we call attention to them.

PERSONAL.

The death of Mr. J. S. Symons, Grand Trunk Engineering Department, is announced.

Mr. F. Phillips has been appointed Chief Engineer of the Cincinnati, Columbus & Hocking Valley Railroad.

Mr. John Lamont, formerly of Boston, has left Texas for the City of Mexico, where he will hold an important railroad appointment.

C. A. Clinton is Chief Engineer of the Kansas City, Springfield & Memphis Railroad Company, with headquarters at Springfield, Mo.

J. C. James, chief engineer of the Chicago & Grand Trunk, is appointed chief engineer of the Canadian Pacific, and will have charge of construction.

Mr. Joseph W. Coburn, who stood beside Lafayette at the laying of the corner-stone of Bunker Hill Monument, is the oldest master-builder in Boston.

Col. J. W. Andrews, late Assistant Superintendent, has been appointed Chief Engineer and General Superintendent of the Midland North Carolina, in place of Major J. B. Yates, resigned.

S. P. Wolverton, of Sunbury, is President; Andrew H. Dill, Treasurer, and Wm Lorenz, of the Philadelphia & Reading, Chief Engineer of the Shamokin, Sunbury & Lewisburg Railroad.

The new excavations at the Forum and Pantheon were thrown open for the first time on the 2,685th birthday of Rome, when Humbert and Margherita visited them, the ruins being illuminated with Bengal lights.

Chief-Engineer George W. Melville, who has been searching for the missing boat and party of the Jeanette, has bright blue eyes, fair skin, weighs one hundred and ninety, is a skilled athlete, and belongs to an old Knickerbocker family.

W. B. Shute, the widely-known railway contractor, of Milwaukee, and Vice-President of the Wells & French Company, bridge and car-builders, of Chicago, died suddenly of paralysis, in Sioux Rapids, May 16. Mr. Shute was a member of the railway contracting firm of Wells, Harrison & Shute.

Suit for Slander.—John S. Bogart has sued Thomas McCann, the Brooklyn contractor, for $10,000 damages for slander. The complainant says that about the 21st of February, 1882, the defendant accused him of dishonest and corrupt transactions while in the employ of the city of Brooklyn.

A historic house in Boston, which has had but one tenant, was never darkened by death nor gladdened by the birth of a child, the home of Wendell Phillips for over forty years, before which Dom Pedro, Kalakaua, and the Prince of Wales took off their hats as they drove by, is to be demolished on account of the extension of an avenue.

Missing.—From the *Railroad Gazette* of May 26 we take the following item: Mr. J. C. Gregg, an old civil engineer, who, when last heard from, was engaged on the Texas and Western Railroad at Beaumont, Tex., has not been heard from since Feb. 22. Information concerning him will be gladly received by his friends, and may be sent to the *Railroad Gazette* office.

William B. Bryan, for four or five years Borough Engineer of Blackburn, Eng., has resigned that position to accept the appointment of Chief Engineer of the East London Water-works Company, at a salary of £1,150 per annum. He stipulated that he should be allowed to superintend the completion of the Blackburn Waterworks scheme, to which he has been devoting attention since its commencement. His present salary is £750.

M. B. Cowden, who for ten years has been City Surveyor for Harrisburg, Pa., was accidentally shot on an island opposite that city on the 20th. A gun club, to which he belonged, had been shooting at glass balls, and near the conclusion of the sport, a gun in the hands of one of the party was discharged within three feet of Cowden, the entire load entering his back under the shoulder. About six weeks ago the Assistant City Surveyor fell dead in the presence of Cowden.

Gen Rosser appeared before the police court at Winnepeg on the 10th on information sworn out by S. R. Reed, of Joliet, Ill., late Chief Engineer of the company, to the effect that he, Rosser, did on the 28th of February obtain possession of the profile of a part of the preliminary surveyed line of the Canadian Pacific Railway from the junction of the Red Deer and Saskatchewan rivers to within fifteen miles of Fort Calgary, and carried away and still retains the same. After the examination of Duncan Shaw, from whom the document was taken away, the court adjourned.

R. Hering, the well-known sanitary engineer, of Philadelphia, has been quite ill for a week at Cleveland, to which city he was recently called to advise in sewerage matters. He is now in Racine, Wis., in consultation over the sewerage of that city. Mr. Hering's recent reports to the city of Philadelphia and the National Board of Health on the sewerage of European cities have met with a wide and unqualified approval, and the careful study and conscientious work bestowed upon them by Mr. Hering has added to the literature of the subject information of incalculable value. We are pleased to know that Mr. Hering's talents as a sanitary engineer of the first rank are being widely appreciated by the urgent demand for his services.

It is curious that a tunnel between Calais and Dover was an engineering dream of the last century. In Sir John Sinclair's correspondence is given an account of a journey he made from London to Paris in 1789, in company with the elder Montgolfier, when upon arriving at Dover they discussed the *pros* and *cons* of a submarine tunnel. They proposed to ventilate it by barrels of compressed air let out in its center. A recent suggestion, curiously enough, was also made at that time:

> "And if the French should come—a rare oh!
> We'll drown 'em as the Jews did Pharaoh."

"The Bubbles of 1825" alludes to the same "happy dispatch"—

> "A tunnel underneath the sea from Calais straight to Dover, sir,
> With sluices made to drown the French, if ever they come over, sir."

"Who Knows?"—It is said in England that the following is the true story of Count de Lessep's second courtship and marriage; but perhaps it is and perhaps it is not: His first wife died when he was 68, and a few years later, the story goes, he became a frequent visitor in a family where there were five sisters. One day he remarked that the Arabs had expressed surprise that he could live without a wife, when one of the sisters innocently asked him why he did not marry then, to which he replied, "Because I am too old. He might fall in love with a young girl, but not she with him." "Who knows?" she said in reply. Some days after this he gave the lady a rose of Jericho, telling her how, after being dried, if placed in water it would burst out into bloom again. She took it, and when he next called brought it back to him, saying, "See what a miracle the water has effected upon the rose; it is the blossoming of love in old age." He met her eyes, and believing there was meaning in what she had said, proposed to her then and there, and was accepted. "But for this marriage," adds the chronicler, "it is very uncertain whether de Lesseps would have undertaken his laborious task at Panama. She is always at his side, and has been his chief help and support throughout his arduous conflicts with politicians, money-lenders, engineers and laborers."

SARATOTGA, M. McGREGOR & LAKE GEORGE RAILROAD.

Length, 10½ miles, from Saratoga Springs to Mt. McGregor, a spur of the Adirondacks. Grading was begun March 17, and is now near completion. Tracklaying is under way and will be completed as fast as trestling is out of the way, of which there is a considerable amount. It is expected to finish tracklaying by June 15, and to open for traffic July 1st. From the foot of the mountain to the top there is a sustained grade (compensated for curvature) of 4 ft. to the 100 or 211 ft. to the mile. Sharpest curvature, 24°.

The company have secured a tract of 1,000 acres on the mountain of an average level of 800 ft. above the springs and the country around; contains 2 fine lakes, and it is intended to make a park of it as an attractive summer resort, on account of the mountain climate and fine views.

H. K. Porter & Co., of Pittsburg, Pa., supply the engines, and Jones & Co., of Schenectady, the cars. The road is being constructed under the personal supervision of John McGee, Engineer and Superintendent.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 158.

CCCXI.—ATTLEBOROUGH.

Attleborough, Massachusetts, in lat. 41° 55 N., long. 71° 22' W., is on Mill River. It was settled in 1696.

In 1873 water-works were built by the town, taking the supply from a well near the river, with three pipes driven in its bottom to a water-bearing stratum and forming flowing wells. Connection is also made with the river for use when fires cause an excessive drought. The water is pumped by a Blake pump, supplemented for service by a Worthington pump, into a plate-iron tank lined with brick laid in cement, and holding 215,000 gallons at about 60 ft. above the town. In case of fire the water is pumped directly into the mains with from 80 to 100 lbs. pressure.

Distribution is by wrought-iron and cement pipe of 8, 6, and 4-in. diameter. There are 5¼ miles in use, with 73 fire hydrants, 40 gates and 350 taps and 97 meters. The town contributes $1,500 yearly to the support of the works. Service pipes are of wrought iron, cement lined.

The population in 1880 was 11,111. The consumption is not stated. The works have cost $82,000 to the present time and the receipts have been $33,314. There is a bonded debt of $61,000 at 7 per cent. interest.

For the year ending May 1, 1879, the expenses for maintenance were $2,764.08 and the receipts from water rates $3,096.42.

The works are managed by a prudential committee of the water supply district.

CCCXII.—CONNERSVILLE.

Connersville, Indiana, in lat. 39° 40 N., long. 85° 8 W., is on the west fork of Whitewater River, on the bottom lands northwest of the river, back of which the bluff rises to a height of 96 ft.

Settled in 1814, it was incorporated as a city in 1869, in which year water-works were built for the city by the Holly Manufacturing Company, taking the supply from the old White Water Valley canal, which passes through the town and has for some years been used ooy to furnish water-power.

The water is pumped directly into the mains by a Holly pump driven by water-power, giving an ordinary pressure of 20 lbs. and fire pressure of 80 lbs.

Distribution is by 3 miles of cast-iron pipe of 8, 6, and 4-in. diameter, with 65 fire hydrants and 175 taps. Lead service pipes are used.

The population in 1880 was 3,226. The consumption is not known. The works cost originally $10,000. No account is kept of the expenses. The receipts for 1880-1 were $1,200 and for 1881-2 were $1,000, the falling off being due to the withdrawal of two railroads.

The works are managed by three trustees elected by popular vote, one retiring every year. One-half the receipts from water rents and an additional sum of $550 raised by taxation go each year to the owners of the water-power, who operate the pumps.

John Verden is the Superintendent, and Anthony Watt, Clerk of the Board.

CCCXIII.—ELYRIA.

Elyria, Ohio, in lat. 41° 28 N., long. 83° 9' W., is on Black River, on level ground.

It was settled in 1815, and, in 1879, water-works were built for a private company by M. S. Frost & Son, after plans of Joseph Flannery, taking the supply from the Black River, across which a stone dam, 4 ft. high and 85 ft. long, forms a basin, from which the water is passed through a stone-walled filter-bed, of 4 ft. of sand, to the pump. A Worthington pump, of 1,000,000 gallons daily capacity, raises the water 100 ft., into a plate-iron tank, 34 ft. in diameter and 20 ft. deep, set on a stone-masonry tower, 80 ft. high, the wall of which is 4½ ft. thick at bottom and 2½ ft. at top. The tank is 75 ft. higher than the city. Distribution is by 8 miles of cast iron pipe, with 50 fire hydrants, 10 gates, 175 taps and 2 meters.

The town pays $60 each per year for fire hydrants.

Service pipes are of galvanized iron.

The population in 1880 was 4,500, and the daily consumption, 300,000 gallons.

No financial statements are furnished.

F. R. Persone is Secretary, Treasurer and Manager of the company.

CCCXIV.—FRANKFORT, KY.

Frankfort, Kentucky, in lat. 38° 12'N. long. 84° 54 W. on the Kentucky River, is on an elevated plain between the river and a bluff which rises to a height of 150 ft. The river flows in a deep channel of limestone rock.

It was incorporated in 1786. Water-works were built by the town in 1841, after the plans of James Judge (?) taking the supply from a spring 2½ miles from the town, to which the water is conveyed in a 6-in. cast-iron pipe. The spring is 33 ft. above the town. A dam of stone was built three-quarters of a mile from the spring to make a stoarge reservoir for the waste water of the spring in the wet season, and a 12-in. pipe laid from it to the town. The stone dam, 200 ft. long, 35 ft. high, 10 ft. wide at bottom and 3 ft. at top, has never held water enough to make this reservoir available, and the pipe was so poorly laid that it has never been used.

The water of a spring is led to a reservoir 30× 80 ft. and 6 ft. deep, built of stone masonry.

Distribution is by cast-iron pipe of 4 and 3-in. diameter.

There are no fire hydrants, 8 gates and 500 taps. Service pipes are of leed and iron.

The population in 1880 was 6,979. The consumption is not known, and no financial statistics are given.

B. F. Meek is chairman of the Water Committee, and Samuel J. Shea the Superintendent.

[TO BE CONTINUED.]

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is acknowledged with thanks: From Anthony Watt, clerk of water-works trustees, statistics and water rates of the water-works of Connersville, Ind. From the Prudential Committee, statistics and water rates of Attleborough, Mass. From F. R. Persone, Secretary, statistics of the water-works of Elyria, O. From Samuel J. Shea. Superintendent, statistics and water rates of the water-works of Frankfort, Ky.

CORRECTION.—May 20, 1882, p. 158.—*Downingtown.*—Last line, for James B. Sivves, read *James B. Simes.* May 13, p. 156.—*Virginia City.*—There are 11 miles of distribution pipe (not 25) and 2,000 taps.

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FRAUDS IN PHILADELPHIA.

PHILADELPHIA, May 22.—The sub-committee of the Water Committee of Councils, appointed about a month ago to investigate the charge that only $300 worth of brick-work had been performed at the Belmont Water-works, for which services the city was charged $1,800, met this afternoon. Chairman Bains, of the sub-committee, submitted a report which stated that the committee had appointed measurers who were instructed to investigate certain brick-laying work reported as having been done at the Belmont Works during January, February, March and April of the current year. This committee reported as a result of its measurement that the work for which the city had been charged $1.848.25 really cost only $770.64, an excess against the city of $1,077.61.

As a result of the above investigation and report, the following was submitted to councils on the 23d:

"*Whereas*, Dr. William H. McFadden, Chief Engineer of the water-works, has by the mismanagement of his department shown a conspicuous want of the ability, care and efficiency requisite to the proper administration thereof; therefor, be it

"*Resolved*, by the joint committee on water-works, that the said William H. McFadden be and he is hereby respectfully requested to resign his position as Chief Engineer of the water-works."

* * * * *

"I have not been asked to speak," said Dr. McFadden. "I have had no opportunity to defend myself. The workmen desire to be heard. I have no interest in their testimony. When I come before a proper tribunal I will a tale unfold of which gentlemen here little dream. For nine years I have been hounded and abused. Why? Because I have suffered no man to control me; because I broke up the East Park Reservoir ring; because I exposed fraudulent claims against the city, and because I sent Water Department thieves to the Penitentiary. My authority is not commensurate with my responsibility. I must depend upon subordinates, and am not permitted to appoint them myself."

Dr. McFadden is to be heard on Monday next.

LOOKING INTO THE STARR PIPE CONTRACT.

In obedience to a resolution recently passed by Councils, the gas committee yesterday afternoon held its first session to inquire further into the contracts by which the gas trustees in 1879 inflicted upon this city a loss of $7,610 in the Jesse W. Starr $46,600 4-in. pipe contract. Walter Wood, of R. D. Wood & Co., produced a letter from Chief Engineer Park, under date of Aug. 20, 1879, inviting proposals for 10,000 12 ft. lengths each of 3 and 4-in. cast-iron pipes, standard weight. In response he bid to furnish the 3-in. pipe, 11 lbs. to the foot, at 13⅝, and the 4-in., 16 lbs., at 22¼ cents per foot. Subsequently he saw Mr. Park and James McManes, was told that heavier pipe would be required, and asked to frame a new bid for 3-in. pipe weighing 12½, and 4-in. pipe weighing 18 lbs. to the foot. He bid 16 9-10 and 23 9-10 cents respectively per foot. The contract was awarded to Mr. Starr. The clerk read several extracts bearing upon the matter from the record of former investigation. The investigation will be continued.—*Philadelphia Times, 22d.*

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ENGINEERS' CLUB OF PHILADELPHIA.

Record of Regular Meeting, April 15, 1882.—President Rudolph Hering in the chair; 24 members and 1 visitor present. Mr. J. J. de Kinder read the first part of his paper upon the construction of dykes, banks, levees, etc., in Holland.

Miscellaneous communications, etc., were presented.

Record of Business Meeting, May 6, 1882.—Mr. D. McN. Stauffer in the chair; 25 members and 3 visitors present.

The memorial to Congress of the American Metrological Society, asking for the adoption of means by which a common meridian might be established for the reckoning of longitudes and local time, was presented and unanimously approved. The pamphlet from the American Society of Civil Engineers upon standard time for the United States, Canada and Mexico, accompanied by questions to interested persons with regard to the various proportions, was presented and discussed.

The objects set forth in House Bill number H. R. 4726, entitled "*A Bill authorizing the President to appoint a commission of experts, skilled in the investigation, production and use of metallic substances and other structural materials, to execute tests and experiments* on *iron, steel and other materials used in the construction of bridges, buildings and mechanical structures and deduce useful rules therefrom*," were unanimously approved and a committee appointed to transmit to our members of Congress the sentiment of the Club upon this subject, and to take such action as might best further the interest in this bill.

The following were declared elected active members of the Club, viz.: I. H. Wingate, Wm. J. Gray, Samuel Rea, Wm. Lorenz, Wm. E. Partridge, Wm. H. Derbyshire, E. M. Seitz, W. W. Coe, D. W. Flickwir, W. C. Wetherill, Washington Jones and W. M. Black.

Mr. Russell Thayer exhibited a section of an underground conduit for electric light, telegraph or telephone wires.

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HARTFORD, May 24.—The contract for building the Valley Railroad extension, from this city to Springfield, Mass., has bean awarded to Adam Driesbeck & Co., of New York.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

SOMETHING FOR THE SCIENTISTS TO INVESTIGATE.—In the town of Riga, this county, the only reliable wells are artesian. There are a large number of these wells in use. From the center of the town north and south, and running back to the west part, these wells range from 70 to 120 ft. deep. In some of them the water rises to the surface, and it is believed that they all strike the same vein of water, the difference in the depth being due to the conformation of the ground. A day before the coming of a northwest wind or a storm from that direction, the water in these wells becomes so muddy as to be entirely unfit for use, and the water has a strong and very disagreeable odor. The only way the farmers obviate this difficulty is to dig a well beside the bored one, tap the pipe below the point to which the water rises, and let it run into the dug well to settle. But all who depend on the water in the bore are afflicted with this changing of its character, which invariably precedes the northeast wind or storm, it acting in the capacity of a barometer, which never fails, but which is exceedingly disagreeable in its operations. The wells subject to these changes are distant about twenty miles from the nearest point on Lake Erie, the whole southern tier of towns in Monroe County having to be crossed to reach the bay. At all other times the water is apparently of excellent quality.—*Adrian (Mich.) Times.*

PHILADELPHIA GAS.—In Common Council chamber President Lex presented a communication transmitted to him by a New York Association, the Hydrogen Company of the United States, through W. W. Harkness, of Philadelphia. The company proposes to lease the Gas Works for twenty years at a five per cent. rental upon a valuation of not less than $12,000,000, nor more than $15,000,000. All needed improvements will be made, the city to take the additional works from the company at their cost, or the lessees to have the privilege of purchasing the works at an appraised valuation at the expiration of the lease. The company guarantees that illuminating gas of 17 candle-power, of uniform composition, of density not to exceed .550 and containing not more than ten per cent. of carbonic oxide, shall be delivered to the consumers at $1.35 per 1,000 cubic feet. Heat gas can be supplied for $1 per 1,000 feet. General Herman Haupt, who in August, 1879, proposed to furnish gas manufactured by the Beatley & Gill process and apparatus to the city is still one of the company's consulting engineers.

The communication was signed by Robert W. Rutherford, William H. Grenelle and James Pearson Gill, president, general manager and chief engineer of the company.

CIVIL SERVICE IN CAMDEN.—The Water Committee of Camden City Council has displaced all the Republican office-holders in the department and substituted Democrats in their places. The committee, which is mainly composed of Democrats, refrained from making any changes, though strongly urged to do so, until the new engine and boilers had been placed in position.

SURVEY.—Engineer E. C. Davis, of Northampton, has been engaged by the Town Committee, of Easthampton, Mass., having the question of the water supply of the town in charge, to make a survey of the Turkey Brook route, including the location of the dam reservoir and the water main to Loudville. This brook is on the east side of Turkey Hill in Westhampton, and would give Easthampton nearly a 250-ft. head of water. It would necessitate nearly four miles of main pipes to reach the village, but most of the way the pipes could be laid in a straight line with easy digging and a down grade. A preliminary survey of the same route was made last year by the students under Prof. Sawyer.

WATER-WORKS ASSOCIATION.—The officials of water-works in New England are about to organize an association. Such a society will be of great service in advancing some of the important questions which concern the management of public water supplies, such as waste, etc.

CORSICANA WATER WORKS.—The City Council has two propositions before it for the building of water-works, and both are considered advantageous. A committee has been appointed to look into the matter, and it is supposed definite action will soon be taken.

STOPPAGE OF WASTE.—Thomas J. Bell, Assistant Superintendent of the Cincinnati, O., Water-works, has successfully introduced the microphone to detect the waste of water in dwellings. The *modus operandi* of detecting leaks is as follows: Place a key on the stop, turn the same partly off; then screw the detector on the key, place your ear to the detector, and if no sound is heard it is evident that no flow of water exists. If a sound is heard, either faintly or loudly, turn the stop entirely off. If a sound is still heard, then the leak exists between the stop and main pipe. In case the box is full of mud, endeavor to force the wooden rod through same to service pipe or stop, and then apply detector to the rod.

GAS WORKS.—The contract for the stone-work of the new gas works of Erie, Pa., has been let, and operations will be commenced in a few days.

CHEAPER INSURANCE AND A WATER SUPPLY.—GALVESTON, TEX., May 20, 1882.—There can be no question as to the great benefit to be derived by Galveston from bountiful supply of fresh water, when obtained; but while waiting for this, under the plan now before the City Council for its approval, which plan provides that work thereon may be commenced within six months after adoption of the ordinance and to be completed in 24 or more months thereafter, is there not a pressing need for a system, using the salt water from the bay, if only for the extinguishment of fires? I propose submitting to the council at its next meeting proposals from parties competent in every particular, capable of giving bond in any amount for faithful performance, to furnish in the district suggested a perfect system, engines, boilers, pumps, necessary buildings, hydrants (triple-plug hydrant at every street intersection), complete; when (and at any subsequent time) as a test eight streams are to be thrown to a vertical height of 100 ft. each, for $49,000. The plan may be variously modified down to $40,875, always ready, only requiring hose to be attached. It can be completed ready for use within six weeks from date of contract, if required. The pipes will be treated to resist the action of soil and climate. It may be extended in any direction when required, say to the cotton presses, depots, etc. When fresh water is obtained this system may be adapted to its use at shortest notice. In the meantime it will have paid for itself twofold if no fire has called for its service. First, to the taxpayers by a reduction in expenditures for the fire department. Second, to the property owners by a reduction of insurance premiums, all within three years from its adoption. Is not this plan worthy of consideration? There are no "millions in it;" not a dollar to any person except the contractors. C. M. MASON.

WILL BUILD WATER-WORKS.—Paris, Ont., Canada, will build $80,000 worth of water-works.

LOAN NEGOTIATED.—The new Phœnixville (Pa.) 4½ per cent. water loan has been negotiated to the extent of $30,000.

NEW ENGINE.—The Board of Public Works of Cincinnati adopted a resolution authorizing the engineer of the water-works to proceed with the construction of an engine in accordance with plans and estimates already made by him. The engine is needed, in order to insure a supply during the summer. It will have a capacity of 33,000,000 gallons.

ARTESIAN WELLS are to be bored at every water station along the line of the Georgia Central Railroad.

THE CORLISS PUMPING ENGINES, originally built for the city of Boston, were inspected by the city officials of Providence on last Saturday. They are now the property of Providence, and are pronounced satisfactory.

REPORT WATER COMMISSIONERS OF ST. LOUIS.—The total cost of operating the water-works and supply system last year was $253,629, an increase of $28,617 over the previous fiscal year. The three low-service engines ran 14,372 hours, used 308,774 bushels of coal, and pumped 9,032,419,000 gallons of water during the year. The three high pressure engines worked 16,814 hours, used 893,808 bushels of coal and pumped 9,852,430,000 gallons. The total expense of repairing and operating the six engines was $184,427, divided into $50,027 for labor, $121,476 for coal and $7,670 for repairs. The cost of pumping 1,000,000 gallons by the low-service engines was $5,329, and by the high service $13,046; total, $18,375. The quantity of sediment removed from the settling basins during the year was 121,190 cubic yards, at a cost of $2,875. One hundred and thirty-four meters were set. The daily consumption was 27,500,000 gallons. At present the water-pipe laid in St. Louis is: 68,414 feet of 3-inch, 9,329 feet of 4-inch, 825,107 feet of 6-inch, 3,570 feet of 8-inch, 46,333 feet of 10-inch, 59,685 feet of 12-inch, 42,038 feet of 15-inch, 82,432 feet of 20-inch, 16,670 feet of 30 inch, 33,213 feet of 36-inch; total, 1,186,811 feet, equal to 224 4-5 miles, of which 47 7-10 miles were laid since October, 1877, or under the new charter. During the year $8,335.63 was expended in removing the sediment from the old reservoir on Benton street, and materials were sold from this reservoir to the amount of $1,276.80.

THE WATER SUPPLY BILL.—The bill to increase the water supply of the District to come up in the Senate as unfinished business, directs the Secretary of War, after making provision for necessary surveys and acquirement of title to the land necessary to extend the aqueduct from its present terminus to the high ground north of Washington, near 8th street extend and to construct at that point a reservoir of capacity of not less than 300,000,000 gallons, to erect the necessary gate-houses, lay necessary main connections, etc., and also to complete the dam at Great Falls to a level of 148 feet above tide, and extend it across Conn's Island to the Virginia shore. The bill appropriates $51,370 to pay for land for the aqueduct extension, and $580,534.35 for the extension; for main connections $165,400; to pay for land for reservoir $35,250; for work and material in constructing reservoir and gate-house, $431,273.75; to pay for water rights and land necessary to extend dam, $45,000; to protect the canal from flooding, $12,800; for work and material to complete the dam, $145,151; making a total appropriation of $1,485,279.80. Full authority to obtain title to all land necessary by condemnation is given the Secretary of War and Attorney General.

ELECTRICITY.

WILL USE ELECTRICITY.—A special election in Xenia, O., recently resulted in favor of electric light by a large majority.

THE BRAZILIAN CABLE SCHEME will, its advocates assert, positively be carried out.

PROPOSED ELECTRIC LIGHT.—It is proposed to light Dubuque, Iowa, with electric light—56,000 candle power—located on eight towers at prominent points in the city.

THE BRUSH-SWAN Electric Light Company, of New England, have filed articles of incorporation at Albany. Capital $2,000,000.

EXPERIMENT in an underground telegraph will be made by Mr. Warrell, a well-known brass founder of Pittsburgh, Pa. Right has been granted by the city. The cable to be used in this experiment is of corrugated lead, 1 inch in diameter, perforated with five small holes, each of which is insulated in a composition which is the inventor's secret, and wrapped in cotton is a fine copper wire. This cable is capable of being increased in size and capacity, and if it is operated successfully wires can be so laid under ground at less expense than they can be stretched on poles.

STREETS, DRAINAGE, ETC.

RECLAMATION OF THE POTOMAC RIVER FLATS.—The Senate committee on improvement of the river front at Washington examined Col. Geo. E. Waring, of Newport, R. I., as to the effect of the flats and the benefits to be obtained from the projected improvement. He testified that on the 18th of last August he made, at the request of Col. Rockwell, an inspection of the White House and grounds, with the view of recommending sanitary improvements. In the spring of 1880 he prepared a paper to be read befor the Smithsonian Institution, and before preparing that he took occasion to examine the Potomac flats and the Anacostia flats very thoroughly. He had also examined the late Major Twining's plan of reclamation, and had talked with him about it. He would approve part of the plan, but would change the proposed order of the work somewhat. He regarded a thorough system of sub-soil drainage for the low-lying portions of the city as necessary in order to remove the prevailing causes of disease. In order to provide such a system for the low grounds it would be necessary to have the sub-soil drainage empty into a canal made for that purpose, to get sufficient fall, and it would have to be removed from this canal and into the river by pumping. Such a thorough system of under-drainage as he proposed would obviate the necessity of filling the flats. In short, he would drain them dry and keep them dry (first building a sea-wall between them and the river) by this system of under-drainage. The proposed plan would, if carried out, be beneficial to the health of the city, but, he believed, not to the extent the committee was seeking. It would undoubtedly, though, be a public benefit to fill the flats.

SEWERAGE SYSTEM.—The City Council, of Winnipeg, has appropriated $500,000 for sewerage.

THE handsome little city of Williamsport is in trouble about its pavements. This is not a particularly new thing, however, since the city has been in trouble about the pavements ever since they were put down and the municipal debt was put up. But the present trouble is rather different from the recent ones. The time has come when something must be done about replacing the pavement, which a dozen years or so ago cost the city something like half a million dollars. It is all worn out and the streets are in a disgraceful condition. Strange as it may seem, there are those who favor repaving with the Nicholson blocks, although the experiment with them has been anything but satisfactory. The chief recommendation is that wood is cheap in Williamsport. One thing the citizens will probably not do this time, no matter what kind of pavement they decide upon: They will not run into debt another six or seven hundred thousand dollars. They have learned that debts can only be disposed of by paying them and they are naturally a little shy about pavements and debts.—*Philadelphia Times.*

SEWER SURVEY.—A survey for the proposed sewer on Pleasant street, Northampton, Mass., is being made, though on just what plan it will be constructed is not yet decided.

STREET IMPROVEMENTS.—The Boston Board of Aldermen has passed orders to pave Broadway extension with small granite blocks, at an expense of $16,200; to pave the sidewalks on Dorchester avenue, between Dorr and Swett streets, at an expense of $20,000; to grade and gravel Norfolk street, between the New York and New England Railroad bridge and Walk Hill street, at a cost of $3,300; to grade and gravel Cushing avenue, from Hancock to Pleasant street, at a cost of $15,500; to underdrain and macadamize a portion of Neponset avenue, between Pope's Hill and Neponset River, at an expense of $15,000.

EIGHTEEN PUBLIC DITCHES, costing in the aggregate over $100,000, are now being built in Wabash County, Ind.

BIDS FOR STREET WORKS.—Bids were opened before the District Commissioners for grading and regulating South Capitol street, from M street to the river, the work consisting of grading, including the hauling, gravelling, laying of bluestone curb, cobble stone gutters and brick sidewalks. Also, for laying asphalt pavement on Sixteenth, from N to R streets northwest, and C, from Third to Four-and-a-half streets northwest. Also granite block pavements on C, from First to Third streets northeast; Third, from C to D streets southeast; C, from Second to Third streets northwest; First, from Massachusetts avenue to H street northwest; First from Defrees to I streets northwest; Nineteenth, from M to N streets northwest; Twenty-sixth, from Pennsylvania avenue to K street northwest; Twenty-ninth, from M to N streets northwest.

The bids for grading and regulating South Capitol street, and granite block pavements on the other streets named above, were as follows:

James Reynolds, grading, per cubic yard, 19c.; hauling, 1c.; gravelling, 8c.; setting curb, 8½c.; laying gutters, 18c.; laying brick sidewalks, 10c.; laying granite block pavements on C, between First and Third streets northeast, 75½c.; on Third, between C and D streets southeast, 75½c.; on C, between Second and Third streets northeast, 75½c.; First, between Massachusetts avenue and H street, 75½c.; First, between Defrees and I streets northwest, 74½c.; Nineteenth, between M and N streets, 80c.; Twenty-sixth, between Pennsylvania avenue and K street northwest, 80c.; Twenty ninth, between M and N streets, 75½c. Mr. Hines (corresponding figures), 18c., —, 18c., 10c., 30c., 9c., 69c., —, —, 68c., 69c., —, —, —. Thos. Joyce, 25c., ½c., 12c., 12c., 40c., 14c., 75c., 73c., 71c., 75c., 75c., 73c., 70c., 72c. Wm. Hussey, 20c., ½c., 8c., 11c., 25c., 10c., 76c., 76c., 76c., 76c., 76c., 76c., 76c., 76c. Patrick Maloney, 22c., ½c., 15c., 8c., 30c., 11c., 66c., 64c., 66c., 67c., 68c., 66c., 64c., 68c. John Cudmore, 19c., ½c., 12c., 10½c., 19c., 9c., 65½c., 66c., 61c., 64c., 64c., 63c., 59c., 56c. Samuel C. Mills and Morris F. Talty, 16c., ½c., 6c., 14c., 26c., 14c., 84c., 84c., 85c., 80c., 80c., 80c., 78c., 78c.

Asphalt Pavement.—A. L. Barber, Sixteenth, from N to R streets, asphalt, $2.26; granite block, $2.58; C, between Third and Four-and-a-half streets, asphalt, $2.26; granite block, $2.58. H. L. Cranford, Sixteenth, from N to R streets northwest, asphalt, $2.28; granite block, $2.60; C, between Third and Four-and-a-half streets, asphalt, $2.28; granite block, $2.60.

The material in all cases of granite block to be furnished by the District. No awards have been made.

SEWERAGE SYSTEM.—At a mass meeting of citizens of Lake View, Ill., held Saturday night last, to consider the question of constructing an independent system of sewerage, resolutions were passed instructing the trustees to conclude negotiations with the city for the use of the Fullerton avenue conduit, and if the city's consent was not obtained, to commence the construction of an independent system on the line of Fullerton avenue.

ST. LOUIS expects to pay $100,000 damages resulting from the Mill Creek overflow.

RIVERS AND HARBORS.

THE WORK OF DREDGING THE WASHINGTON (D. C.) CHANNEL of the river is still progressing successfully, and the island formed by the mud excavated is about 8 acres in area.

A BIG DIKE.—A Frenchman has laid before the Académie a brilliant scheme for producing perpetual spring in England and France by constructing a dike 500 miles long across the North Sea, to keep out the cold currents of water and floating ice.

RAILROADS.

WE can scarcely comprehend the magnitude of the railroad work being done beyond the Pecos. While we are going quietly about our business, hundreds of men are at work forging a passage-way for the iron horse through the mountains and ravines of Western Texas, and through trains from San Francisco will come whirling along here almost before we know it. Two years ago a trip from here to El Paso was a weary and tedious one, often filled with danger; in a very few months it can be made in a Pullman palace car, right on a good portion of the line the stages used to traverse. —*San Antonio Express.*

THE *Two Republics*, of the City of Mexico, remarks: Railway construction advances. From the capital toward the north and from the Rio Grande south the iron bands are hastening to meet. The day is not far distant when the connection will be made, and the tourist taking the cars at New York will alight in the City of Mexico with hardly a change. With railway communication accomplished, travel toward Mexico will increase, commerce be stimulated and the two countries bound in closer accord. The Mexican Central Railroad is pushing straight for the northern frontier, and is also rapidly advancing south. The progress made by this road is truly remarkable.

ELEVEN hundred men are now employed on the main line extension of the Milwaukee, Lake Shore & Western Railway.

IT is rumored that the Grand Trunk will build an extension from Charlotte to Kalamazoo, which will tap Hastings, Mich.

GRADERS are busy on the Little Falls & Dakota Railroad.

NOTWITHSTANDING the work on the International is now suspended in Mexico, a full corps of draftsmen are kept at work at Laredo in making maps and profiles of the work on the extension to the city of Mexico; besides, the work on the costly iron bridge across the Rio Grande is being pushed rapidly every day in the week, Sunday not excepted, which is an evidence that the suspension of work in Mexico is only temporary.

THE Fremont & Lincoln Railroad is under contract to Fitzgibbons, of Plattsmouth. There is an arrangement with the Chicago, St. Paul, Minneapolis & Omaha Railroad, by which the latter will run its trains to Lincoln when the road is completed. The projected track is through an easy country, and it is probable that the road can be finished for business some time this year. The grading on the Scotland line is delayed by the wet weather of last week, and will not be finished this month. The bridging is to be completed by July 4. It looks now as if the road would not be surfaced up ready for regular trains before the last of July.—*Sioux City Journal.*

THE RISING WATER in Red Chute Swamp delays the work of construction on the Vicksburg, Shreveport and Pacific railways.

MAYBE A MAN FEELS HAPPY and proud, and flattered, and envied, and blessed among men when he sees a pretty girl trying to raise a window on a railway car, and he jumps up and gets in ahead of the other boys, and says: "Allow me!" oh, so courteously. And she says: "Oh, if you please, I would be so glad," and the other male passengers turn green with envy, and he leans over the back of the seat and tackles the window in a knowing way with one hand, if peradventure he may toss it airily with a simple turn of the wrist; but it kind of holds on, and he takes hold with both hands, but it sort of doesn't let go to any alarming extent, and then he pounds it with his fist, but it only seems to settle a "leetle" closer into place, and then he comes around, and she gets out of the seat to give him a fair chance, and he grapples the window and bows up his back, and tugs, and pulls, and sweats, and grunts, and strains, and his hat falls off, and his suspender buttons fetch loose, and the vest-buckle parts, and his face gets red, and his feet slip, and people laugh, and irreverant young men in remote seats grunt and groan every time he lifts, and cry out, "Now, then, all together!" as if in mockery, and he busts his collar at the forward button; and the pretty young lady, vexed at having been made so conspicuous, says in her iciest manner: "Oh, never mind; thank you! It doesn't make any difference," and then calmly goes away and sits down in another seat; and that wearied man gathers himself together and reads a book upside down—oh, doesn't he feel good, just.—*Burlington Hawkeye.*

THE West Shore & International Bridge Railway Company; capital, $250,000, to run from Cheektowaga, Erie County, to the International Bridge, in Buffalo, has been incorporated.

THE St. Paul, Kasson & Iowa Railway Company has been incorporated, to build a line of railway from St. Paul southward to Kasson, Dodge County, and from thence to the Iowa State line. The officers are: L. R. Cowdery, President; William Wheeler, Vice-President; L. G. Nelson, Secretary; George B. Arnold, Treasurer.

WHATEVER the future may bring about, little credence should be given to the reports from New York in regard to an accomplished consolidation of the Boston, Hoosac Tunnel & Western with other roads. The road in question holds the contract of the Continental Construction Company to extend the road to Buffalo and other points, and should the courts of New York decide that the charter of the road is a legal one, as is now likely to be the result, there is also a contract with responsible English and Canadian parties to take the construction of the road from the hands of the Continental Company and complete it. It is very probable that there will be important developments in connection with the Boston, Hoosac Tunnel & Western before long, of which the public will be advised.

A CONTEMPORARY says the Massachusetts Central Railroad Company paid its employés a month's wages on Tuesday, but is still about seven weeks behind in its payments. The employés, while inclined to grumble, are still willing to await the result of the adjourned stockholders' meeting on June 1, when it is believed a plan for adjusting all the financial difficulties will be decided upon.

THE Lake George extension of the Delaware & Hudson Railroad and Canal from Glens Falls to Caldwell will be completed June 1. This does away with the stage line.—*Boston Journal*

THE ASHLAND BRANCH.—Ashland (Wis.) *Press:* A party of engineers, under Division Engineer Carrington, have been engaged during the past week in running a line for a branch road into Ashland from the North Wisconsin Railroad. The new road will have two tracks into town, one running along the bay front to the saw mills, and the other to a connection with the Wisconsin Central's depot grounds. We have not seen the profile of the new survey yet, but are informed that no difficulties are encountered, and that the line will be easy to construct, with light grades and curvature. When the work of building the connection will be commenced we are not informed, but it is confidently expected by our mill-men that the road will be completed to Ashland and operated this fall.

RAILROAD CONSTRUCTION SINCE JANUARY 1.—NEW YORK, May 20.—It will, as *Public* truly says, astonish many to be told that the number of miles of railroad built thus far this year is 2,508, against only 1,018 reported at the corresponding date last year, 1,264 in 1880, 498 miles in 1879 and 312 in 1878. Reckoning the cost of roads at the rates current when contracts for labor and material were made, we may estimate that the new railroads built since January 1 must have cost nearly $75,000,000. It would not be surprising if, after a partial failure of crops, an investment of capital at a rate of nearly $16,500,000 per month in fixed forms should temporarily exhaust the supply available for railroad building.

THE MEXICAN NATIONAL.—The $3,000,000 additional subscription to the Mexican National subscription closed on Monday. This completes the lines of the road respectively to Monterey, Celaya and Morelia on the main division now building. Completion to these points gives the system a mileage of 789 miles of track. Monterey will be reached by Sept. 1. The other points in October.

THE OREGON RAILWAY AND NAVIGATION COMPANY.—The stockholders of this concern are to be called upon at the annual meeting in Portland, Oregon, June 19, to sanction the construction of a large addition to their present mileage, as will be seen by the following statement of new construction proposed: First, a line from the city of Walla Walla, in Washington Territory, in a generally northeasterly direction to Snake River, at or near Texas Ferry, and thence following the valley of the Snake River to Lewiston in Idaho Territory, with a branch from a point on said line about three miles south of Grange City, in a generally easterly direction, to the said city of Lewiston. Second, a line from the said city of Walla Walla to the town of Pendleton in the county of Umatilla in the State of Oregon. Third, a line from a junction with the present railroad of said company, between the Dalles and Umatilla in the State of Oregon, at a point at or near the mouth of John Day's River, up the valley of said river a distance of about 90 miles to the big bend of said river, with a branch from said line from a point at or near the mouth of Rock Creek, up the valley of said Rock Creek to a point about 30 miles distant from the mouth thereof. Fourth, a line from a junction with the road of said company, extending from the Dallas to Umatilla in the State of Oregon, at or near the mouth of Willow Creek, up the valley of Willow Creek to the town of Heppner. Fifth, a line from a point of junction with the present located line of said company's road from Umatilla to Baker City, at or near the mouth of Butter Creek, up the valley of Butter Creek to a point 30 miles distant from the said point of junction.

THE CANADIAN PACIFIC.—WINNIPEG, Manitoba, May 22.—Gen. Rosser, recently chief engineer of the Canadian Pacific, was to-day committed by a police magistrate for trial on a charge of appropriating certain plans owned by the company. Bail was accepted in $4,000.

Chief Davidson, of the Manitoba Southwestern, has retired, and returned to New York, W. E. Teasdale being appointed acting chief engineer.

A RACE TO DEVIL'S LAKE.—Grand Forks (Minn.) *Plain Dealer:* A gentleman whose statement can be relied upon arrived in Grand Forks yesterday, and stated that in an overland trip from Devil's Lake he had run across two large surveying parties. One party represented the St. Paul, Minneapolis & Manitoba Railroad and the other the Northern Pacific road, and both seemed to be running a grand race for the Devil's Lake region. When discovered, both parties were encamped about 20 miles west of Larimore. The Northern Pacific surveyors evidently started out from the Mayville terminus, and while both were running lines in the general direction of Devil's Lake, one line was bearing toward the north of Stump Lake and toward the town of Wamduska, and the other was bearing toward the south shore of the lake, and toward Fort Totten. The same gentleman also brought in the information that the foreman for Col. O. L. Towner, of the Elk Valley Farming Company, started out of Larimore one day behind the party, with a complete camping outfit, prepared for a long siege, and would follow the surveyors for the purpose of definitely ascertaining where the line will go, and of selecting eligible locations for town sites.

THE ONTARIO & QUEBEC RAILWAY.—It is said that Mr. Hugh Ryan, of Perth, was on Tuesday of last week accepted as a member of the C. P. Syndicate. The qualifications which operated in making the ballot for his acceptance "clear" were his financial reputation, and his large experience as a contractor. At the meeting in New York on that day it was decided to proceed at once with the Ontario & Quebec Railway from Toronto to Ottawa, the link from Perth to Sharbot Lake being taken up first. $5,000,000 will be spent upon this work, $2,000,000 of which are now placed at Mr. Ryan's disposal. It is the policy of the syndicate to give the control and management of the different divisions of their work to separate members. Thus Mr. Van Horn has charge of the lines in Manitoba and the Northwest, Mr. McIntyre looks after the Canada Central, its extension, and the Quebec, Montreal & Ottawa, and Mr. Ryan will be responsible for the Ontario & Quebec.—*Central Canadian.*

ATCHISON, TOPEKA & SANTA FE.—A dispatch from Atchison, Kan., says: "The intelligence that the Atchison, Topeka & Santa Fe road has succeeded in their loan for $10,000,000 satisfactorily in London at 6 per cent., quickens the railroad pulse in this centre. The fact that this gigantic corporation had laid off 2,000 men from active employment in less than two weeks between here and Old Mexico was seriously considered. In conversation with Contractor J. S. Fiske, who operates the entire improvement force in Atchison, he stated that, although he had not received express orders for such action, the intimation was that he might prepare for work."

A NEW WISCONSIN ROAD.—Surveyors are now going over the route for the Galesville & Trempealeau Railroad. It is impossible to form any opinion in regard to the result of this railroad project. It will receive strong opposition, but may possibly succeed.

OPERATIONS IN WISCONSIN.—Eleven hundred men are now employed by the Milwaukee, Lake Shore & Western Railway Company on the main line extension north of Summit Lake, in Langdale County, the present operating terminus.

TEXAS ROAD.—The construction train of the East Line Railroad has reached McKinney. The depot has not yet been located.

PROGRESS IN IOWA.—The track of the Chicago, Milwaukee & St. Paul has reached Dedham. The roadmaster states that the road will be finished to Council Bluffs by July 4.

RAILROAD AND BRIDGE CONTRACTS.—Reports received at the offices of the Wisconsin & Michigan Railway state that the surveys on the Ontonagon & Brule River line have completed the survey from the terminus of the constructed portion of the Ontonagon road to Iron River on the Wisconsin state line, and will return to Ontonagon at once. The officials say it is a straight and low-grade route, and will connect at Iron River, with the Wisconsin & Michigan. The officers of the latter road are about to let contracts for the construction of the bridge work on the twenty-five miles of road in process of grading. They are seriously contemplating letting a contract for another twenty-five miles grade, north of the terminus of the last contracted portion of road. This will take the line within twenty miles of Iron River, on the state line.

RICHMOND, VA.—The dock connection trestle and bridge of the Richmond & Alleghany Railroad was tested by the officials on the 13th, and the road opened for traffic. Extensive improvements are planned for the dock property owned by the railroad; side tracks, new wharf-lines and store-houses will be built, and also coal-chutes and other facilities for the quick loading of vessels.

ROUTE SURVEYED.—A route has been surveyed from Fond du Lac to Oshkosh for the Milwaukee & Lake Winnebago Railway Company.

EXTENSION COMPLETED.—The Denver Extension of the Chicago, Burlington & Quincy from the Missouri River to Denver was completed Thursday. There has been a great deal of enterprise shown in this work. As many as three miles of track have been laid in one day during the progress of the work.

TEXAS MEXICAN RAILROAD.—The track is now 100 miles from Laredo. Over two miles were laid on May 18.

THE ST. LOUIS & SAN FRANCISCO.—A dispatch from Springfield, Mo., says Engineer M. L. Randall, of the St. Louis & San Francisco Railroad, who surveyed the Arkansas branch, will start from this place next Monday to survey a line of a proposed branch of the 'Frisco Railroad from Springfield to Harris, Ark., going by way of Ozark. No definite conclusion has yet been formed as to the route or the objective point, which will depend largely upon the report of the engineer.

PROJECTED ROAD.—The New Orleans *Picayune* states that Mr. R. T. Wilson, formerly President of the East Tennessee, Virginia & Georgia road, has consummated arrangements under which he proposes to build a line from New Orleans, on the east bank, via Baton Rouge and Vicksburg, to along Deer Creek, through the Yazoo Valley to Memphis, Tenn., with a branch leading from a point on the main line to the Mississippi River, opposite Arkansas City, and also a branch from near Vicksburg to Yazoo City.

THE NORTHERN PACIFIC RAILROAD COMPANY.—This company has in its eastern division main line 970½ miles of completed road and in its western division main line 380½ miles, making a total mileage on May 1 of 1,351, or an increase of 360 miles since Jan. 1, 1881. Between the eastern and western divisions there is a gap of 593 miles. It is calculated that 400 miles of this gap will be built this year, leaving to be constructed in 1883 only 193 miles, when there will be a continuous road between Lake Superior and St. Paul in the East and Portland and Puget Sound in the West

PROPOSED RAILWAY EXTENSION.—Officers of the Gulf, Colorado & Santa Fe Railway Company, operating 500 miles in Texas, are in Chicago conferring with the Chicago & Alton Railroad officials, and have submitted a proposal that the latter extend its lines from Kansas City to the northern boundary of the Indian Territory; that the Gulf, Colorado & Santa Fe Railroad extend its lines from Fort Worth to the southern boundary of that territory, and that the two interests unite in a third company and build a line across the Territory 100 miles west of the Missouri, Kansas & Texas, each road to bear half of the expense, and the Gulf road to send 400,000 bales of cotton yearly over the Chicago & Alton Railroad. The latter give very little encouragement to the plan.

THE LAKE GEORGE RAILROAD.—The work of laying the track of the new Glens Falls and Lake George Railroad is completed.

W. & M. R. R.—Mr. Dawson, of the contracting firm of Dawson, Symmes & Co., arrived in Green Bay, and will at once begin preparations for the grading work on the Wisconsin & Michigan line. The contract taken by this firm for the construction of 25 miles of road above Stiles, will be placed in charge of a general construction superintendent, who will in turn sublet the entire work. The State line will probably not be reached before the end of the season of 1883.

* * *

BUILDINGS.

OFFICE BUILDING.—Parke Goodwin will erect a nine-story building for stores and offices, which will front on Nassau street, Liberty street and Liberty Place, N. Y., on the site of the old *Evening Post* building. It will cost $189,700, and will be constructed of stone, terra cotta and iron. A. J. Bloor is the architect.

SCHOOL-HOUSE.—Fergus Falls, Minn., will build a school-house to cost $23,300.

ANNAPOLIS, Md., wants $100,000 from Congress for the construction of a public building within her small limits.

NEW AXLE WORKS.—Messrs. Hubbard, Bakewell & Co., have about completed their new axle works on the Allegheny River, near Pittsburgh. There are three buildings in all, the forge department being 300×50 ft., the grinding and polishing department, 348×46 ft., and the engine and boiler house, 228×50 ft.

HANNIBAL, Mo., will have a government building, whose cost must not exceed $75,000.

LARGE UNION DEPOT.—HIAWATHA, Kan., May 20.—At a railroad meeting here to-day, Col. A. S. Everest and Superintendent Harding, of the Missouri Pacific, made a proposition to the city to make Hiawatha the headquarters of a division, and to build here the largest union depot on the line, car works and repair shops, in consideration of the donation of the local stock in the company and ten acres of land. The proposition was unanimously accepted and the contract signed. Col. Everest says work will be begun on the car shops before June 1. There is great enthusiasm here over the important event.

FORT IMPROVEMENTS.—The plans and specifications for the improvement of Fort Omaha, Nebraska, so as to make a ten-company post, contemplate an expenditure of $162,892, for which Congress will at once be asked to make an appropriation.

THE NEW ENGLAND MARBLE COMPANY has filed articles of incorporation at Albany. Capital, $500,000.

BIG ROOF TRUSS.—The big trusses of the steel mill roof at Indianapolis are 120 ft. long—the largest span in the State—with a pitch of 20 ft. or near it, and as the huge triangle slowly mounts to its place it gives to an intelligent observer a good idea of engineering forces employed in modern work. Each of the three sides of the triangle is formed of five heavy timbers, breaking joints and studded with the heads of bolts compacting them as solidly as if they were a single stick, and far more strongly. They are strong enough to make sills for a railroad bridge.

SLAKED AND NOT SLAKED.—The London *Builder* attributes the marvelous durability of mortar in Italy to the fact the lime remains in a pit covered with water for two years before it is used, whereas in England lime is slaked and used the same day. Most building specifications even require newly slaked lime.

To Erect Shops.—The Milwaukee & Northern Railway Company have decided to erect in Fort Howard a building to serve as general shops for the present uses of the road. It will be located on their Tanktown property, south of the side track. The building will cost $4,500, and is to be constructed for use for general purposes until the anticipated demand for something on a large scale for car-shops, and then to be transformed into paint shops.

The steel works projected at Batesville, Ark., will cost, it is estimated, $400,000. They are to be erected and ready for operation this year.

New Cotton Mill.—Subscriptions are being solicited for a $500,000 mill in Dallas, Tex. W. G. Veal is at the head of the committee.

BRIDGES.

Failure of a Bridge Company.—The Cleveland Bridge and Car Works, at Cleveland, Ohio, have made an assignment. The company recently applied to increase the capital stock from $100,000 to $500,000, but the negotiations were not completed. Maturing paper to the amount of $6,000 went to protest a few days ago. The condition of the company in February, as given by the President, showed assets, $792,004, and liabilities, exclusive of capital stock, $545,091, leaving a nominal surplus of $246,913. The contracts on hand amounted to $1,000,000, and 700 men were employed. The business was started in 1851 in a small way, under the style of Thatcher, Burt & Co. The business was bought by H. M. Claflin, as trustee for the present company. The officers are Henry M. Claflin, President; S. Sheldon, Engineer, and John H. Ashburn, Secretary.

The Cleveland Bridge and Car Works Company have made an assignment to H. F. Sweetzer, of Titusville, and W. H. McCurdy, of Cleveland, who gave bonds in $25,000, and who will complete the contracts and continue the business of the company. The 700 employés were paid off as far as contracts demanded, and in a few days they will be paid to May 1. President Claflin states that the assignment was forced by the pressure of obligations and the difficulty of obtaining ready money. He says that the company's assets are $250,000 greater than its liabilities; that it has contracts to construct $250,000 worth of bridges for the Lake Shore, "Nickel-Plate," Bee Line, Chicago & Atlantic, and Cleveland, Mount Vernon & Columbus railways, and to build about 700 cars, and that the works are worth $825,000, including upward of $100,000 in real estate. The exact assets and liabilities cannot be given for some time. Mr. Claflin thinks the company will be able to resume business in sixty or ninety days.

J. R. Smith, of Springfield, Mass., has sued the city of Holyoke for $10,000 to recover a balance of $5,000 due for reconstructing the "free" bridge. The authorities claim that the work is defective, and decline to pay till it is made satisfactory.

Bridge Construction Authorized.—The Senate passed the bill authorizing the Texas & St. Louis Railway Company to build bridges in Arkansas over the White River, near Clarendon; over the Arkansas River, near Pine Bluff; over the Sabine River, over the Ouachita River, and over the Red River in Lafayette County where the line of the company crosses.

Wagon Bridge.—Work has been commenced on the $25,000 wagon bridge across White River, near Freedom, Indiana.

Plans have been submitted by Chief Surveyor Smedley, of Philadelphia, for the new Market street bridge over the Schuylkill.

Bridge in Springfield, O.—A new bridge is to be erected on East High street, across the railroad tracks.

The Keystone Bridge Company will commence the erection of the long span of the P., V. & C. R. R. bridge across the Monongahela, at Brownsville, about the 1st of June.

The Corrugated Metal Co., of New Berlin, Ct., have now on hand 5 spans, 150 ft. each, for Lowell, Mass.; 1 span, 198 ft., for Conway, Mass.; 4 spans plate girder, for N. Y., N. H. & H. R. R.; 3 spans plate girder, for Danbury & Norwalk Railroad; 1 span, 204 ft., for Waterbury, Conn.; 3 spans plate girder, for Eastern Railroad; 1 span, 90 ft., for North Adams, Mass.; 2 spans, 62 ft. each, West Waterville, Me.; besides a large iron roof for N. Y., N. H. & H. R. R., at New Haven, Conn.

The C., B. & Q.—Atchison, Kan., May 22.—Instead of building a new Missouri River bridge the Chicago, Burlington & Quincy is now talking of a transfer-boat at Rulo, and a branch to the Kansas City and Council Bluffs at Bigelow. This increases the distance from the West to St. Louis and the South 21 miles, and there is nothing to be gained by it except saving the bridge toll at Atchison and the pull over the Troy Hill. Engineers state that they desire to shorten the route and save expense, but this is not practicable as proposed.

Washed Away.—Nearly every bridge in Sonora township, Hancock County, Ill., was washed away by the recent floods.

The New Iron Bridge of the Connecticut River Railroad across the Connecticut at Bellows Falls, Vt., was thoroughly tested May 18 and trains began crossing it.

The Highest Bridge.—It is said that the Cañon Diablo bridge, on the Atlantic & Pacific Railroad, north of Prescott, Arizona, is the highest bridge in the world, with one exception. From the bottom of the cañon to the center of the bridge the distance is about 290 ft.

New Bridges.—The Senate bills authorizing the Texas & St. Louis Railway Company to build bridges in Arkansas and to incorporate the Garfield Memorial Hospital were passed.

The Mexican Method.—City of Mexico, May 22.—Five men who attempted to destroy a bridge on the Mexican National Railway, on Friday last, were caught yesterday, and, by order of the Governor of the State of Mexico, they were immediately shot.

LABOR.

The Pay Fixed for Boston Laborers.—Boston, May 25.—The Common Council to-night passed an order fixing the pay of city laborers at not less than $2 per day.

Strikers.—Ninety-six laborers and 18 machine men employed at J. C. Dreyfuss & Co.'s brickyard, Jersey City, struck for $60 and $65 a month, respectively, an advance of $10. The yard uses silt from the Hudson River Tunnel. The men were discharged and yard is closed. Either Italians or Chinese will be hired.

Strikers.—The bricklayers are habitual strikers. It is their habit to arrange their rate of wages with the builders at the beginning of the season, with the understanding that it is to be adhered to by both parties during the summer. Invariably, however, they make further demands at the height of the season, until their wages are higher than those of any class of laborers among the building trades. This practice of violating faith with the bosses has been severely condemned by other trade union organizations, whose members claim that such a course will not only injure the building trade, but will have a depressing effect on all other trades. The bricklayers of this city now receive $4.50 a day, and they assert that no more demands will be made this year. It is believed by many, however, that next month another strike will be made for an additional 50 cents a day. The trades in which successful strikes have been made so far this season are the bricklayers, stone-cutters, carpenters, painters, plasterers, fresco painters, coach-painters, framers, coopers, cigar-makers, shoemakers, horseshoers, upholsterers, bluestone-cutters and flaggers, some comparatively unimportant trades. Besides these, the hod-carriers made a successful strike. The trackmen on the Hudson River branch of the New York Central Railroad obtained a concession of 15 cents a day from the company; and in several other branches of unskilled labor, such as the marble polishers, cartmen, street sweepers, helpers to artisans and others, an advance of wages was secured.—*N. Y. Tribune.*

The striking tracklayers near Council Bluffs, Ia., on the Chicago, Milwaukee & St. Paul, have gone to work at the old rates. Enough laborers are offered to take the place of the strikers should the company conclude to dismiss the men.

The Finance Committee of Philadelphia Councils has reported favorably an ordinance increasing by 10 per cent. the wages of all mechanics in the city's employ.

The Castle Garden Labor Bureau.—The Castle Garden Labor Bureau reports that of the vast number of immigrants arriving at Castle Garden last week, only ten remain without employment; also, that the demand for all sorts of laborers from almost all parts of the country is as urgent as ever, and that in almost every instance liberal wages are offered. The big steamer City of Rome brought 1,500

The plumbers of this city demand $4 per day.

CONTRACTS LET.

A Huge Contract.—The contractor who has taken the contract to construct 85 miles of the western end of the Canadian Pacific upon the Pacific Coast has made arrangements to import 8,000 Chinamen, 1,200 of whom have already arrived. Upon this contract the work from Emory to Thompson's River, a distance of 60 miles, is probably the most difficult and expensive on the North American continent. In the first seventeen miles there are thirteen tunnels, four in one mile and six in another. In two miles on the division above Emory there are no less than 600 trestles and bridges, and in the last 85 miles more than 100 embankments, which at the foundation level are 17 ft. while and the cuts 22 ft. The tunnels are 22 ft. wide and 21 ft. high. In the upper section of the work there are 10,000,000 cubic yards of earth, an excavation of 3,000,000 cubic yards of rock, exclusive of the tunnel, and 2,000,000 cubic yards of rock and cemented gravel. Between 30,000,000 and 40,000,000 ft. of timber, board measure, are required for the structures. Over the entire contracts the rock is of the hardest compact granite, in which often occur wide and extremely rich quartz veins. For miles the road is literally hewn out of the side of the cliffs. The approaches to many of the tunnels are galleries. At the eastern approach to tunnel No. 7, for over 100 ft., the bluff is galleried, and overhangs the roadway twenty-four feet in width, or two feet outside the road-bed, below which is an almost perpendicular precipice of 200 ft

Pipe Contract Let.—A dispatch from Madison, Wis., states that the contracts for furnishing the pipes for the water-works, laying the mains, supplying the hydrants, drilling the wells, and in fact all contracts except those relating to the pumping machinery, have been signed. The work of laying the mains will begin just as soon as the pipe is on the ground, though this will not be for some little time yet, as the manufacture of it has not yet begun.

Davis Island Dam.—The contract for furnishing the iron and steel work for the Davis island dam has been awarded to the Pittsburgh Bridge Co.

Stationery Contract Let.—Contracts for furnishing certain articles of stationery for immediate use in the Treasury Department have been awarded to F. G. Fisher, J. D. Free, Jr., Wm. Ballantyne & Son, of Washington; E. D. Lockwood, of Philadelphia, and White, Corbin & Co, of Rockville, Conn.

Bids for Furnishing Labor for the new court-house at Baltimore were recently opened. M. A. McGowan, of Washington, was the lowest bidder, $38,987, and will probably be awarded the contract. For furnishing bricks and skew-backs, the Maryland Brick Company, of Baltimore, were the lowest bidders. Bids for the court yard roof and ceiling of the custom house at Cincinnati were also opened. Snead & Co., of Louisville, Ky., were the lowest bidders—$51,889.

State of Trade in South America.—From the Buenos Ayres *Herald* of the 11th ult. we take the following: In many respects the condition of the country never was better. Trade is good; money is plentiful; the provincial paper currency, which, in spite of the mint and the comparatively heavy work going on there, is likely to be the favorite circulating medium for a long time to come, is at par, at which rate it is likely to remain all the winter. The camps are in good condition, sheep increasing to such an extent that thousands have to be sold off by those who are unwilling to assume the responsibility of more land, and the prices of produce are very remunerative to farmers and agriculturists.

Contract for Valve Chambers.—The Atlas Works, Limited, have the contract to furnish two new valve chambers for the engines at the Pittsburgh Waterworks, the specifications calling for a tensile strength of 25,000 lbs. The iron they have purchased for the above castings is the "Muirkirk" brand, made at Muirkirk Furnace, Md., and specimens of it, tested on Gill's testing machine, show a tensile strength of 42,300 lbs.

Court-House.—The County Commissioners of Austin, Minn., awarded the contract for the superstructure of its court-house to Solomon Snow, Esq., of Chicago. His bid was $52,000, but it is expected to reduce this some thousands by changing the finishing of the interior.

Gas Fixtures.—For furnishing gas chandeliers for the new State, War and Navy departments, Shreve, Crump & Low, of Baltimore, were the lowest bidders, $6,094.50. Edward Caverly, of Washington, was next, $6,398.50. The awarding of the contract will depend upon the quality and the designs offered.

Water-Works Contract Let.—The City Council of Geneseo, Ill., has made a contract with P. H. Perkins to have the water-works put in first-class shape. A new fire-proof engine-house will be built, and the improvements are to be completed by July 1.

MISCELLANEOUS.

Washington, May 18, 1882.—The Senate to-day disposed of the Milson, Spendelow & Watson claim for an extension of their patent right in the steam grain-shovel used at Buffalo, by indefinitely postponing its consideration, the vote being 25 to 21. Three new interferences were declared by the Patent Office to-day between the claims of Brush and Faure, and upon their result will depend the ownership of valuable improvements in secondary electric batteries.

City of Mexico, Mex., May 14.—Congress has granted the exclusive privilege to the Bell Telephone Company to sell and operate its instruments in Mexico.

A Fall in Telephone Stock.—London, May 19.—In the Chancery division of the High Court of Justice, Justice Fry to-day gave judgment in the case of the United Telephone Company *vs.* Walker, an action to restrain the defendant from infringing on the patent for Edison's transmitter and Bell's receiver. The former point was decided against and the latter in favor of the plaintiff. Shares have, in consequence, fallen heavily.

Council Bluffs Water-Works.—The Council Bluffs Water-Works Company began on the 17th the construction of the water-works system arranged for over one year ago.

A Whopper.—The Cincinnati *Commercial* tells the (perhaps a) big story of a big walnut tree. In 1864 an Indiana man, as the story runs, bought the tree for $1, and he subsequently sold it for $65. The buyer sold it to a Cincinnati lumber-dealer for $700. The Cincinnati dealer sold it to a New Yorker for $2,200, and he cut it up into veneering, which he sold for $27,000.

It has been ascertained that Christopher Columbus was not the discoverer of the way to make an egg stand on end. He was a plagiarist. It was the great Florentine architect, Brunelleschi, who adopted the oval-shaped egg as a model for the dome of the cathedral at Florence. He stood the egg on end while illustrating the idea, and as he died in 1444, and Columbus was born in 1436, the priority of the discovery belongs to the Florentine. And so another historical fact is knocked out of the geography.

Old Soup.—During the war of 1812 the firm of Daggett & Kensett, of New Haven, contracted to supply the army with canned soup, and this was the initial step in an industry which is now of enormous extent and importance. Two cans of that soup are now in the possession of William Daggett, of Indianapolis, a grandson of the man who put them up, and, so far as can be judged from the appearance of the cans, which are still air-tight, though the tin has worn off from the heavy iron body, the soup is all ready for another war.

Window Shutters.—For fire-proof shutters for the public building at Philadelphia, the lowest bid was that of the United States Fire-proof Shutter and Safe Company, of Boston, at $118,235.50, and the contract will probably be awarded to that firm.

How He Would Have Saved the Jeannette.—Kirk, the powder man, this morning, whacked a cartridge of Hercules powder upon the pavement in a way that made the writer's blood run cold. "I could have saved the Jeannette with a lot of these cartridges," said Kirk. "One winter I proved the explosive in an ice gorge and blew a channel open in ten minutes. Had the crew of the Jeannette been provided with these cartridges placed in holes bored in the ice and fired by a battery the ice would have been shattered as it slowly advanced and thus have been rendered powerless to crush the vessel.—*Pittsburgh Telegraph.*

Out of Pocket.—The contractor for the Outagamie County court-house, at Appleton, just completed, is said to be out of pocket $5,000, owing to the unprecedented advance in building materials.

Tunnel Accident.—By the fall of an overhanging rock in the Union Hill, N. J., tunnel of the N. Y., O. & W. R. R. on the 25th, two men were killed outright, and a third so badly injured that he will probably die. There were 1,300 men at work in the tunnel at the time. The contractors are Smith, Ripley & Coleman. The accident, near Shaft No. 4, was at a depth of 135 ft.

OFFICERS OF THE CORPS OF ENGINEERS, U. S. ARMY.

STATEMENT SHOWING THEIR RANK, DUTIES AND ADDRESSES, JANUARY, 1882.

Brigadier General and Chief of Engineers.

Horatio G. Wright, Bvt. Major General, Washington, D. C.—In command of the Corps of Engineers and in charge of the Engineer Department. Charged with the supervision of such matters connected with construction of jetties and other works at South Pass, Mississippi River, as require the action of the Secretary of War.

Member of Joint Commission to supervise the construction of the Washington National Monument. Member of Light-House Board. Directed by the President to co-operate with the authorities of the State of New York in examining and deciding upon exterior pier and bulkhead lines on Hudson River from State dam at Troy to the city of Hudson.

Colonels.

Henry W. Benham, Bvt. Major General, 7 Waverly Place, New York City.—In charge of the construction of Forts Winthrop, Independence and Warren; work on Long Island Head, and field works on the coast from Provincetown to Gloucester, Mass.; Forts Montgomery, Columbus, Wood and Hamilton and additional batteries, Castle Williams, South Battery, Governor's Island, Mortar Battery at Fort Hamilton, N. Y., and fort at Sandy Hook, N. J.

John N. Macomb, 1,125 Girard street, Philadelphia, Pa.—In charge of the construction of Forts Delaware, Del., and Mifflin, Pa., battery at Finn's Point, N. J., and work opposite Fort Delaware, Del.

Chairman of Commission Advisory to Board of Harbor Commissioners of Philadelphia.

Z. B. Tower, Bvt. Major General, Army Building, New York City.—President of the Board of Engineers.

Member of Board of Engineers on improvement of Charleston Harbor, S. C.; of Board of Engineers on improvement of Pass Cavallo Inlet, Aransas Pass and Bay, and entrance to Galveston Harbor, Tex.; of Board of Engineers on improvement of Savannah River and Harbor, Ga., and Member of Board of Officers on Inventions of Heavy Ordnance and Projectiles, etc., in accordance with act of Congress approved March 3, 1881.

John Newton, Bvt. Major General, Army Building, New York City.—Member of the Board of Engineers, in charge of the improvement of the Harbors at New York, Roundout, Port Chester, New Rochelle, and of Echo Harbor, N. Y.

In charge of the improvement of the Hudson River, Harlem River, Flushing, Sheepshead and Canarsie bays, East Chester and Newtown creeks, and Buttermilk Channel, channel in Gowanus Bay, and Sumpawams Inlet, N. Y., South and Raritan rivers and Cheesequakes Creek, N. J.; removal of obstructions in the *East River*, including Hell Gate, N. Y.

In charge of the manufacture and supply of Mastic, and examination of Brooklyn Bridge, N. Y.

Member of Board of Engineers on improvement of Charleston Harbor, S. C.; of Board of Engineers on improvement of Pass Cavallo Inlet, Aransas Pass and Bay, and entrance to Galveston Harbor, Texas; of Board of Engineers on improvement of Savannah River and Harbor, Ga., and of Court of Inquiry upon Lieutenant Colonel Warren's conduct as Major General commanding the Fifth Army Corps at battle of Five Forks, Va., on April 1, 1865. Directed by the President to co-operate with the authorities of the State of New York in examining and deciding upon exterior pier and bulkhead lines on Hudson River from State dam at Troy to the City of Hudson.

George Thomas, Bvt. Brig. General, Box 1989, Portland, Me.—In charge of the improvement of the Harbors at Belfast, Portland, Rockland, Richmond (Kennebec River), Richmond's Island, Me., Portsmouth, N. H., Newburyport, Boston (including sea-walls on Point Allerton, Great Brewster Island, Lovells' Island, Long Island Head, Rainsford Island, and Deer Island, also channel leading to Nantasket Beach), Plymouth, Provincetown and Scituate, Mass.

In charge of the improvement of the rivers Saint Croix (repairing breakwater near Calais), Cathance, Back (at "Gut" opposite Bath), and Kennebunk, Me., Lamprey and Exeter, N. H., Merrimac, Mystic and Charles, Mass., Lubec Channel, Moose-a-bec Bar at Jonesport, Me., and of Lake Winnipiseogee, N. H.

In charge of the examination or survey of Harbor of Brunswick, on the Androscoggin River, Me., Channel of Harriseeket River from Weston's Point to Freeport Landing in Freeport, Me.; Merrimac River from Lawrence, Mass., to Manchester, N. H.; and Lynn Harbor, Mass.

William F. Raynolds, Bvt. Brig. General, 532 Walnut St., Phila., Pa.—On detached service; Engineer 4th Light-house District.

Lieutenant Colonels.

Charles S. Stewart, San Francisco, Cal. In charge of the construction of fortifications at Fort Point, Point San Jose, and Angel Island, in San Francisco Bay, and at San Diego, Cal.

In charge of the improvement of the Harbor at San Diego, Cal. Senior Member of Board of Engineers for the Pacific Coast.

Charles E. Blunt, Bvt. Colonel, Portland, Me.—In charge of the construction of forts Gorges, Preble, Scammel, Popham, Knox and battery at Portland Head, Me., and forts Constitution and McClary, and batteries on Jerry's Point and Gerrish's Island, Portsmouth Harbor, N. H. Engineer 1st and 2d Light-house districts.

James C. Duane, Bvt. Brig. General, P. O. Box 2128, New York City.—On detached service. Engineer 3d Light-house District.

Robert S. Williamson, San Francisco, Cal.—Member of Board of Engineers for the Pacific Coast. Engineer 12th Lighthouse District.

Quincy A. Gillmore, Bvt. Major General, P. O. Box 1647, New York City.—In charge of the construction of forts Wadsworth, Tompkins and its batteries, N. Y.; Monroe and Wool, Va.; Macon and Caswell, N. C.; Moultrie, Sumter, Johnson and Castle Pinckney, S. C.; Jackson and Pulaski, Ga.; Clinch and Marion, Fla.

In charge of the improvement of the Harbors at Charleston, S.C.; Savannah and Brunswick, Ga.

In charge of the improvement of Ashley River and Wappoo Cut, S. C.; of the bar at the mouth of St. John's River, and of the inside passage between Fernandina and St. John's, Fla.; Volusia Bar, Fla.; Cumberland Sound, Fla. and Ga.; Savannah and Altamaha rivers and St. Augustine Creek, Ga.

In charge of the examination or survey for opening of steamboat communication from the Saint John's River, Fla., by way of Topokalija Lake, to Charlotte Harbor or Pease Creek; of Savannah River and Harbor, Ga., and Indian River, Fla.

Member of Board of Engineers on improvement of Charleston Harbor, S. C.; of Board of Engineers on improvement of Pass Cavallo Inlet, Aransas Pass and Bay and entrance to Galveston Harbor, Tex.; of Board of Engineers on improvement of Savannah River and Harbor, Ga. Member and President of "The Mississippi River Commission," created by Act of Congress, approved June 28, 1879.

Thos. Lincoln Casey, Bvt. Colonel, Washington, D. C.—In charge of the construction of the building for the State, War and Navy departments; of the Washington Aqueduct and the construction of the Washington National Monument.

John G. Parke, Bvt. Major General, Washington, D. C.—In charge of the 3d Division, office of the Chief of Engineers.

Gouverneur K. Warren, Bvt. Major General, Newport, R. I.—In charge of the construction of Defenses of New Bedford Harbor, Mass., and Narragansett Bay, R. I.

In charge of the improvement of the Harbors of Nantucket, Hyannis, Wareham and Wood's Holl, Mass.; Newport and Block Island, R. I.

In charge of the improvement of the Rivers Taunton, Mass.; Pawtucket, Providence and Potowomut, R. I., and Connecticut, Mass. and Conn.; Narragansett Bay, R. I., and Little Narragansett Bay, R. I. and Conn.

In charge of the examinations or surveys of Edgartown Harbor and South Beach, and Buzzard's and Barnstable bays, Mass., at entrance of proposed Cape Cod Canal.

Member of Board of Engineers upon bridging the Ohio River.

George H. Mendell, Bvt. Colonel, San Francisco, Cal.—In charge of the construction of the fort on Alcatraz Island and of defenses at Lime Point, San Francisco Bay.

In charge of the improvement of the harbor at Oakland, Humboldt Harbor and Bay and of the construction of the breakwater at Wilmington Harbor, Cal.

In charge of the improvement of Sacramento and San Joaquin rivers and Petaluma Creek, Cal.

In charge of the examination or survey of Mokelumne River, Cal., from its mouth at or near Woodbridge; to devise a system of works to prevent further injury to navigable waters of California from the débris from the mines, with estimates of the costs of such works.

To investigate causes tending to decrease depth of water and diminish the commercial value of San Francisco Harbor.

Member of Board of Engineers for the Pacific Coast.

Henry L. Abbot, Bvt. Brig. General, Whitestone, N. Y.—Member of the Board of Engineers.

In charge of the construction of Fort Schuyler and fort at Willets Point, N. Y., and of experiments with torpedoes.

Commanding Engineer Depot and Post of Willets Point, Engineer School of Application and Battalion of Engineers.

William P. Craighill, 70 Saratoga St., Baltimore, Md.—In charge of the construction of defenses of Baltimore, Md., and Washington, D. C.

In charge of the improvement of the harbors at Baltimore, Annapolis, Queenstown, and of the inner harbor at Cambridge, Md., and Onancock harbor, Va.

In charge of the improvement of the channel of Susquehanna River above and below Havre de Grace, and work at the Fishing Battery light station near Spesutia Island; of the Chester, Wicomico, Pocomoke, Elk, Northeast, and Choptank rivers, Treadhaven and Secretary creeks, and water passage between Deal's Island and Little Deal's Island, Md.; Broad Creek, Del.; James and Appomattox rivers, Va.; New River, Va. and W. Va., Great Kanawha, Shenandoah and Elk rivers, W. Va., and Cape Fear River, N. C.

In charge of the examination or survey of channel of Broad Creek, west side of Kent Island, Corsica Creek, upper thoroughfare leading into Tangier Sound, Deil's Island and Rock Creek, Md., and of survey of James River to ascertain the practicability and cost of procuring a channel 25 ft. at full tide, from Richmond to mouth of river; Skipton Creek, Md., and Bush River, Md., from Harford Furnace to Chesapeake Bay. Surveys across the peninsula of Maryland and Delaware to connect by canal the waters of the Delaware and Chesapeake bays.

In charge of the building of the monument at Yorktown, Va.

Cyrus B. Comstock, Bvt. Brig. General, Detroit, Mich.—In charge of the survey of Northern and Northwestern lakes. Member of "The Mississippi River Commission," created by Act of Congress, approved June 28, 1879.

Majors.

Godfrey Weitzel, Bvt. Major General, Detroit, Mich.—In charge of the construction of harbor of refuge on Lake Huron.

In charge of the Louisville and Portland Canal and of St. Mary's Falls Canal; of the improvement of the Falls of the Ohio, St. Mary's Falls Canal, and of the rivers St. Mary and Detroit, Mich.

In charge of the removal of wreck of steamer Nile from Detroit River.

Member of Board of Engineers upon bridging the Ohio River.

Engineer 11th Light-house District.

Orlando M. Poe, Bvt. Brig. General, Headquarters of the Army, Washington, D. C.—On detached service, Aide-de-Camp on the personal staff of the General of the Army with the rank of Colonel.

Member of Light-house Board.

Charged with the sale of a portion of Fort Gratiot Military Reservation.

David C. Houston, Bvt. Colonel, Milwaukee, Wis.—In charge of the improvement of the harbors at Milwaukee, Racine and Kenosha, and harbor of refuge at Milwaukee Bay, Wis., and Waukegan, Ill.

In charge of the improvement of the rivers Fox and Wisconsin.

George H. Elliot, Washington, D. C.—In charge of the 1st and 2d Divisions, Office of the Chief of Engineers.

Henry M. Robert, Milwaukee, Wis.—In charge of the improvement of the harbors at Ontonagon, Eagle Harbor, Marquette, Manistique, and harbor of refuge at Grand Marais, Mich.; Menomonee, Green Bay, Ahnepee, Two Rivers, Manitowoc, Sheboygan, Port Washington, Kewaunee, and Oconto, Wis.; and harbor of refuge at entrance to Sturgeon Bay Canal, Lake Michigan.

Advisory Engineer for improvement of Kewaunee Harbor, Wis.

William E. Merrill, Bvt. Colonel, 82 West Third street, Cincinnati, O.—In charge of the construction of ice-harbors at or near Cincinnati, and mouth of Muskingum River, Ohio.

In charge of the improvement of the Ohio River, the Monongahela River, W. Va. and Pa., and the Allegheny River, Pa.

Member of Board of Engineers upon bridging the Ohio River.

Engineer 14th Light-house District.

Walter McFarland, Oswego, N. Y.—In charge of the construction of Fort Wayne, Mich., and forts Porter, Ontario and Niagara, N. Y.

In charge of the improvement of the harbors at Dunkirk and Buffalo on Lake Erie; Olcott, Oak Orchard, Charlotte, Pultneyville, Big Sodus, Little Sodus, Oswego and Wilson, on Lake Ontario, and Ogdensburg and Waddington on the river St. Lawrence.

In charge of the improvement of Niagara River, N. Y.

Orville E. Babcock, Bvt. Brig. General, 1 Courtland street, Baltimore, Md.—On detached service; Engineer 5th Light-house District.

John M. Wilson, Bvt. Colonel, Scofield Block, Cleveland, O.—In charge of the improvement of the harbors at Port Clinton, Monroe, Toledo, Sandusky, Huron, Vermillion, mouth of Black River, Rocky River, Cleveland, Fairport, Ashtabula, Conneaut and Erie, on Lake Erie.

In charge of the improvement of Sandusky River, O.

Franklin Harwood, Bvt. Lieut. Colonel, Detroit, Mich.—In charge of the improvement of the harbors at Cheboygan, Au Sable and Sebewaing, on Lake Huron, harbor of Alpena at Thunder Bay, harbors at Charlevoix, Frankfort, Manistee, Ludington, Pentwater, White River, Muskegon, Grand Haven, Black Lake, Saugatuck, South Haven and St. Joseph, and water-channel leading up to Benton Harbor, and harbor of refuge at Portage Lake, on Lake Michigan.

In charge of the improvement of Saginaw, Grand and Clinton rivers, Michigan, and removing bar at ice-harbor of refuge at Belle River, Michigan.

In charge of the examination or survey for harbor at Caseville, Lake Huron.

In charge of St. Clair Flats Canal.

John W. Barlow, Bvt. Lieut. Colonel, New London, Conn.—In charge of Forts Griswold and Hale, and the construction of Fort Trumbull, Connecticut.

In charge of the improvement of the harbors of New London, Stonington, New Haven, Bridgeport, Milford, Southport and Norwalk, Conn., and Port Jefferson, N. Y., and of the construction of Breakwater at New Haven, Conn.

In charge of the improvement of the rivers Housatonic and Thames, Connecticut.

In charge of the examination or survey of harbors of Madison and Clinton, Conn., and Greenport and Mamaroneck, N. Y.; and of the survey for breakwater and harbor of refuge at Milford, Conn.

Peter C. Hains, Bvt. Lieut. Colonel, Charleston, S. C.—On detached service; Engineer 6th Light-house District.

Francis U. Farquhar, Bvt. Lieut. Colonel, Office of the Light-house Board, Washington, D. C.—On detached service; Engineer Secretary to Light-house Board.

George L. Gillespie, Bvt. Lieut. Colonel, Room 59, Army Building, New York City.—In charge of the improvement of the harbors of Plattsburg, N. Y., Burlington and Swanton, Vt.

In charge of the improvement of the Ticonderoga River, N. Y.; Shrewsbury, Rahway, Elizabeth, Manasquan and Passaic Rivers, Raritan Bay, and Woodbridge and Mattawan Creeks, N. J.; Otter Creek, Vt., and channel between Staten Island and New Jersey.

In charge of the removal of the wreck of bark Samarang, near Sandy Hook, N. J.

In charge of the examination or survey of harbor at Port Henry, Channel between North Hero and South Hero, Lake Champlain, New York Bay between Sandy Hook and Coney Island Point, and from point between Ellis Island and docks of New Jersey Central Railroad to point between Robbins' Reef Light and Constable Hook, New York Bay.

Charles R. Suter, 1351 Washington Avenue, St. Louis, Mo.—In charge of the improvement of the rivers Mississippi and Missouri, removal of snags, etc.; and of the Missouri River at the following localities: St. Charles, Cedar City, Glasgow, Lexington, Kansas City, Fort Leavenworth, Atchison, St. Joseph, Brownville, Nebraska City, Eastport, Plattsmouth, Omaha, Council Bluffs, Sioux City, Vermillion, and from Kansas City to its mouth; and of Gasconade River.

In charge of the examination or survey of Missouri River at or near Arrow Rock, and of Nishnabotana from Hamburg, Iowa, to its junction with the Missouri.

In charge of the survey of the Missouri River from its mouth to Sioux City, Iowa, and to Fort Benton, Mont.

Member of "the Mississippi River Commission," created by Act of Congress approved June 28, 1879.

Member of Board of Engineer Officers on protection of river front at New Orleans, La.

Engineer Fifteenth Light-house District.

Jared A. Smith, Indianapolis, Ind.—In charge of the improvement of the harbors at Michigan City, Ind., and New Buffalo, Mich.

In charge of the improvement of the rivers Wabash, Ind. and Ill., and White, Ind.

Samuel M. Mansfield, Bvt. Lieut. Col., Galveston, Tex.—In charge of the improvement of the harbors at Galveston and Brazos Santiago, Tex.

In charge of the improvement of ship channel in Galveston Bay, Pass Cavallo, Aransas Pass and Bay up to Rockport and Corpus Christi, Brazos River, Buffalo Bayou, deepening channel at mouth of Trinity River and removal of obstructions to Liberty, and the protection of river bank at Fort Brown, Tex.

In charge of the examination or survey from Brazos de Santiago through Laguna Madre to Point Isabel, Tex.

Garret J. Lydecker, Columbia Building, Four-and-a-half street, Washington, D. C.—On detached service; Engineer Commissioner of the District of Columbia.

William R. King, Chattanooga, Tenn., in charge of the improvement of the rivers Tennessee, Tenn. and Ala.; Cumberland above and below Nashville, Ky. and Tenn.; Red, Hiwassee, Caney Fork, Obey's, Duck, French Broad, and Clinch, Tenn.; Oostenaula, Coosawattee, Etowah, Oconee, and Ocmulgee, Ga., and Coosa, Ga. and Ala.

In charge of the examination or survey of Chattahoochee River, Ga.; Bear Creek, Little Tennessee River from mouth on the Holston or Big Tennessee River to mouth of Tellico River, and Cumberland River at Smith's Shoals, Ky., to ascertain the practicability and cost of canal, with locks and dams, from the head to foot of said shoals.

Wm. H. H. Benyaurd, Memphis, Tenn.—In charge of the improvement of the harbors at Memphis, Tenn., and Vicksburg, Miss.

In charge of the improvement of Tensas River, La.; Ouachita River and Bayou Bartholomew in La. and Ark., and Bayou Bœuf, La., and Cypress Bayou, La. and Tex.; of mouth of the Red River, La., and Upper Red River from Fulton to head of Raft; of the rivers Big Sun Flower, Coldwater, Yazoo, Yallabusha and Tallahatchie, and Tchula Lake, Miss., and the Mississippi River at Memphis, Natchez, Vidalia, and Vicksburg, and the Big Hatchie River, Tenn; of removal of raft, snags, and other obstructions from Red River and of closing Tones' Bayou.

In charge of the water gauges on the Mississippi River and its principal tributaries.

In charge of the examination or survey of Bear Creek, running into Yazoo River, and Big Black River, Miss.

Member of Board of Engineer Officers on protection of river front at New Orleans, La.

Amos Stickney, P. O. Drawer 432, New Orleans, La.—In charge of the construction of Forts Jackson, St. Philip, Livingston, Pike, and Macomb, Tower Dupré, Battery Bienvenue, and Tower at Proctorsville, La.

In charge of the improvement of the Harbor at New Orleans, La.

In charge of the improvement of the Amite, Vermillion, Tangipahoa, Tickfaw, Tchefuncte, and Calcasieu rivers, bayous Terrebonne, Teche, Black, and Courtableau, La., Calcasieu Pass, La., Pearl River, Miss., and of removal of obstructions in Bayou La Fourche, La.

In charge of the surveys for a breakwater in Lake Pontchartrain, and the examination or survey of bayous Plaquemine, Grand Caillou, Little Caillou, Fusilier, Grand Lake, Atchafalaya River from Berwick's Bay to mouth of Red River, Bogue Chitto River from its mouth to Franklinton, and Bogue Falia from its mouth to 25 miles above Covington La., West Pearl River, Pass Manchac, and Bayou Manchac, La., from its mouth to the Mississippi River.

Member of Board of Engineer Officers on protection of river front at New Orleans, La.

James W. Cuyler, 82 West Third St., Cincinnati, O.—In charge of the improvement of the Little Kanawha and Guyandotte rivers, W. Va., the Big Sandy River, W. Va. and Ky., and the Kentucky and Tradewater rivers, Ky.

In charge of the examination or survey of Licking River from its mouth to Falmouth, Ky.

Captains.

Alexander Mackenzie, Rock Island, Ill.—In charge of the improvement of the harbors at Fort Madison and Muscatine, Iowa, Rock Island and Galena, Ill.

In charge of the improvement of the Mississippi River, from St. Paul to Des Moines Rapids; from Des Moines Rapids to the mouth of the Illinois River; at Quincy, Quincy Bay, and Andalusia, Ill.; at Hannibal, Louisiana and Alexandria, Mo.; and of the Upper Mississippi River and Rock Island Rapids and Des Moines Rapids of the Mississippi River; Galena and Cuivre rivers; and of removing bars in Mississippi River opposite Dubuque and Guttenberg, Ia.

In charge of operating the Des Moines Rapids Canal.

In charge of survey for harbor of refuge in Lake Pepin, at Stockholm, Wis., and Lake City, Minn.

Oswald H. Ernst, 404 Market St., St. Louis, Mo.—In charge of the improvement of Mississippi River between the mouths of the Illinois and Ohio rivers, and at Cape Girardeau, and Minton's Point, Mo., and of Osage River in Missouri and Kansas.

In charge of construction of Ice-harbor at St. Louis, Mo., and improvement of harbor and Mississippi River at Alton.

In charge of the examination or survey of Fish Bend near Fort Chartres, Mississippi River.

Member of Board of Engineer Officers on protection of river front at New Orleans, La.

David P. Heap, temporarily care Messrs. Munroe & Co., No. 7 Rue Scribe, Paris, France.—On leave of absence.

William Ludlow, Bvt. Lieut. Colonel, 1125 Girard St., Philadelphia, Pa.—In charge of the improvement of the harbors at Wilmington, Del., Chester, Pa., and at other places on Delaware River and Bay, ice-harbors at Marcus Hook, Pa., and Newcastle, Del., and of the construction of pier near Lewes, Del.

In charge of the improvement of the Salem and Rancocas rivers and Cohansey Creek, N. J.; Delaware, Christiana, Broadkiln, and St. Jones rivers, Duck and Mispillion creeks, Del.; Chester Creek, Schuylkill River and Susquehanna River from Richard's Island up, Pa.; and Delaware River, below Bridesburg, Pa.; between Bridesburg and Trenton; near Cherry Island Flats, and at Schooner Ledge.

In charge of the examination or survey of Frankford Creek from its mouth in Delaware River to Frankford Avenue, Five Mile Point below Bridesburg, mouth of Mispillion and Murder Kiln creeks and Indian River, Del., Newton and Mantua creeks, and Maurice, Salem and Cohansey rivers, N. J.; Delaware River, harbor at Delaware Breakwater, Delaware River below League Island, and Ice-harbor at the head of Delaware Bay near Morris Liston's or Reedy Island.

William A. Jones, Presidio of San Francisco, San Francisco, Cal.—On detached service; Engineer Officer, Military Division of the Pacific and Department of California.

Andrew N. Damrell, Bvt. Major, Mobile, Ala.—In charge of the construction of defenses of Mobile, Ala., and Pensacola, Fla., and of fort on Ship Island, Miss.

In charge of the improvement of the harbors at Pensacola and Cedar Keys, Fla., and Mobile, Ala.

In charge of the improvement of the rivers Chattahoochee, Appalachicola, Suwanee and Withlecoochee, Fla., Flint, Ga., Alabama, Ala., Pascagoula and Noxubee, Miss., Warrior and Tombigbee, in Ala. and Miss., Escambia, Fla. and Ala., Appalachicola and Tampa bays and Peace Creek, Fla., and removal of obstructions in the Choctawhatchee River, Ala. and Fla.

In charge of the examination and survey of Tombigbee River, Miss., Dog Island Harbor, harbor of Key West, Crystal River, La Grange Bayou up to Freeport, Manatee River and Crooked River, Fla., outlet of harbor of Ship Island, harbors at Biloxi and Pascagoula and Old Town, Creek, Miss.

Charles J. Allen, Bvt. Major, Box H, St. Paul, Minn.—In charge of the improvement of the harbors at Duluth and Grand Marais, Minn.

In charge of the improvement of the rivers St. Croix, Chippewa and Minnesota, of the Red River of the North and entrance to Superior Bay; of the Falls of St. Anthony and of the Mississippi River above the Falls of St. Anthony.

In charge of the construction of Meeker's Island lock and dam, of lock and dam at Goose Rapids on Red River of the North, of dam at Lake Winnibigoshish for reservoirs at headwaters of the Mississippi River, and protection of sand banks on the Chippewa River, Wis.

In charge of the examinaton of the sources of the rivers Mississippi, St. Croix, Chippewa and Wisconsin, with the view of ascertaining the practicability and cost of creating and maintaining reservoirs, etc., and of headwaters of Rock River, Wisconsin and Illinois.

In charge of the examination or survey of Beaver Bay, Minn., for harbor of refuge, and of Grand Portage Bay and Wauswau-goising Bay, Minn., to determine which, if either, should be made a harbor of refuge; headwaters of Cannon River, Minn., with view that same may be added to reservoir system of Upper Mississippi.

Charles W. Raymond, Whitestone, N. Y.—Commanding Company A, Battalion of Engineers.

L. Cooper Overman, Nashville, Tenn.—On duty under the immediate orders of Major King.

Alexander M. Miller, Whitestone, N. Y.—Commanding Company B, Battalion of Engineers.

Milton B. Adams, Erie, Pa.—On duty under the immediate orders of Major Wilson.

Wm. R. Livermore, San Antonio, Tex.—On detached service; Engineer Officer, Department of Texas.

William H. Heuer, 87 Union St., New Orleans, La.—In charge of the construction of Forts Jefferson and Taylor, Fla.

In charge of the improvement of Sabine Pass and Blue Buck Bar, and Sabine River, La. and Tex., and Neches River, Tex.

In charge of surveys through Sabine Lake and River to Orange and through Sabine Lake and Neches River, to Beaumont.

To report upon the depth and width of a channel secured and maintained by Jetties constructed by James B. Eads at the mouth of the Mississippi River.

Engineer 7th and 8th Light-house districts.

William S. Stanton, West Point, N. Y.—On detached service; on duty at the Military Academy as instructor of Practical Military Engineering, Military Signaling and Telegraphy, and in command of Company E, Battalion of Engineers.

In charge of extension to cadet barracks, of new water-works and supply line, West Point, N. Y.

Thomas H. Handbury, Little Rock, Ark.—In charge of the improvement of the Arkansas River—removal of snags, etc., Arkansas River between Fort Smith, Ark., and Wichita, Kans., and at Pine Bluff, and of rivers St. Francis, White, L'Anguille, Fourche Le Fève, Saline, and Black, Ark., and Current, Mo. and Ark.

James C. Post, Jacksonville, Fla.—On duty under the immediate orders of Lieutenant Colonel Gillmore.

James F. Gregory, 21 Honoré Block, Chicago, Ill.—On detached service; Aide-de-Camp on the personal staff of the Lieutenant General of the army with the rank of Lieutenant Colonel; Engineer Officer, Military Division of the Missouri.

Henry M. Adams, Washington, D. C.—In charge of the 4th and 5th divisions, office of the Chief of Engineers.

James Mercur, 59 Main street, Norfolk, Va.—In charge of the improvement of the harbors at Norfolk, Va., and Beaufort, N. C.

In charge of the improvement of the Blackwater, Nottaway and Archers' Hope rivers, and Pagan Creek, Va.; Neuse, Scuppernong, Pamlico, Yadkin, Trent, Tar, Lillington and Cape Fear rivers, Currituck Sound, Coanjok Bay, North River Bar, Contentnia and Town creeks, N. C.; North Landing River, Va. and N. C.; and Waccamaw, Great Pee Dee, Wateree and Santee rivers, S. C.

In charge of the examination or survey of bar at mouth of Winyah Bay, near Georgetown, S. C., the water connection between Waccamaw and Cape Fear rivers, Oregon Inlet, and Whiteoak, Meherrin and New rivers, N. C.

Advisory Engineer to National Board of Health in the establishment of a national quarantine station in Hampton Roads, Va.

Member of Board Advisory to State Harbor commissioners of Norfolk and Portsmouth, Va.

Chas. E. L. B. Davis, Buffalo, N. Y.—On detached service; Engineer 10th Light-house District.

Benjamin D. Greene, P. O. Box 96, Charleston, S. C.—On duty under the immediate orders of Lieutenant Colonel Gillmore.

George M. Wheeler, P. O. Lock Box 93, Washington, D. C.—On detached service in connection with the International Exhibition of Geography at Venice, Italy.

James B. Quinn, 2828 Washington Ave., St. Louis, Mo. Temporarily Osceola, Ark.—On detached service; in charge, and disbursing officer, of works on the Mississippi River under supervision of "The Mississippi River Commission," created by act of Congress, approved June 28, 1879.

Daniel W. Lockwood, P. O. Drawer 432, New Orleans, La.—On duty under the immediate orders of Major Stickney.

Ernest H. Ruffner, Charleston, Kanawha County, W. Va.—In local charge of the improvement of the Great Kanawha River, under the immediate orders of Lieutenant Colonel Craighill.

John C. Mallery, Whitestone, N. Y.—Commanding Company C, Battalion of Engineers.

Clinton B. Sears, West Point, N. Y.—On detached service; on duty at the Military Academy as Assistant Professor of Natural and Experimental Philosophy. In charge of the construction of the new Astronomical Observatory at West Point.

Thomas Turtle, 70 Saratoga St., Baltimore, Md.—On duty under the immediate orders of Lieutenant Colonel Craighill.

Edward Maguire, P. O. Lock Box 2124, St. Paul, Minn.—In charge of the improvement of the Yellowstone River and of the Missouri River above the mouth of the Yellowstone.

Engineer Officer, Department of Dakota.

Frederick A. Mahan, P. O. Box 70, Pittsburgh, Pa.—On duty under the immediate orders of Maj. Merrill.

Charles F. Powell, Portland, Oregon.—In charge of works of defense at the mouth of the Columbia River.

In charge of the improvement of the harbor at Coos Bay, and entrance to Yaquina Bay, Oregon.

In charge of the construction of the canal around the Cascades of the Columbia River, and of the improvement of the rivers Willamette, Yamhill, Columbia, Snake, Skagit, and Cowlitz; mouth of Coquille River, and Lower Clearwater River, Idaho.

In charge of the examination or survey of Columbia River at the Dalles, Young's, Lewis' and Clarke's and Skipanon rivers, near mouth of Columbia River, Ore., Snake River from Lewiston to mouth of Salmon River, Idaho; entrance to Gray's Harbor, between Baker's Bay and Shoalwater Bay, Wash., for canal for light-draught vessels; survey of Chehalis River, Wash.

Engineer 13th Light-house District.

Frederick A. Hinman, P. O. Drawer 42, Milwaukee, Wis.—On duty under the immediate orders of Major Houston.

First Lieutenants.

Albert H. Payson, San Francisco, Cal.—On duty under the immediate orders of Lieutenant Colonel Stewart and of the Board of Engineers for the Pacific Coast.

John G. D. Knight, 244 Federal street, Boston, Mass.—On leave of absence.

Richard L. Hoxie, Columbia Building, Four-and-a-half street, Washington, D. C.—On detached service; Assistant to the Engineer Commissioner of the District of Columbia.

William L. Marshall, 2828 Washington avenue, St. Louis, Mo. Temporarily, Duncansby, Miss.—On detached service; in charge and disbursing officer of works on the Mississippi River under supervision of the Mississippi River Commission, created by act of Congress, approved June 28, 1879.

Joseph H. Willard, Whitestone, N. Y.—Adjutant and Treasurer of the Battalion of Engineers and Post of Willets Point and Signal Officer Post of Willets Point. Commanding Company D, Battalion of Engineers.

Eric Bergland, West Point, N. Y.—On detached service; on duty at the military academy as Assistant Professor of Ethics and Law.

Philip M. Price, Cascade Locks, Wasco County, Ore.—On duty under the immediate orders of Captain Powell.

Francis V. Greene, 1915 G street, N. W., Washington, D. C.—On detached service. Assistant to the Engineer Commissioner of the District of Columbia.

Carl F. Palfrey, Whipple Barracks, Prescott, Ariz.—On detached service; Engineer Officer, Department of Arizona.

William H. Bixby, care of Drexel, Harjes & Co., 31 Boulevard Haussmann, Paris, France.—On special duty in Europe.

Henry S. Taber, West Point, N. Y.—On detached service; on duty at the military academy as Assistant Instructor of Practical Military Engineering, and with Company E, Battalion of Engineers. Assistant Engineer West Point water supply. Officer in charge of Post schools. Member of Railroad Board at West Point.

William T. Rossell, Portland, Me. Temporarily Ashville, N. C.—On duty under the immediate orders of Colonel Thom, on leave of absence.

Thomas N. Bailey, Fort Leavenworth, Kans.—On detached service; Engineer Officer, Department of the Missouri

Thomas W. Symons, Vancouver Barracks, Vancouver, Wash.—On detached service; Engineer Officer, Department of the Columbia.

Smith S. Leach, 2828 Washington avenue, St. Louis, Mo.—On detached service; Secretary and disbursing officer of "The Mississippi River Commission," created by act of Congress, approved June 28, 1879.

DAN C. KINGMAN, Omaha, Neb.—On detached service; Engineer Officer, Department of the Platte.

EUGENE GRIFFIN, Whitestone, N. Y.—Q. M. Battalion of Engineers, A.A.Q.M., A.A.C.S. and Recruiting Officer, Post of Willets Point.

WILLARD YOUNG, West Point, N. Y.—On detached service; on duty at the Military Academy as Assistant Professor of Civil and Military Engineering.

WILLIAM M. BLACK, 1125 Girard street, Philadelphia, Pa.—On duty under the immediate orders of Captain Ludlow, Secretary to Commission Advisory to Board of Harbor Commissioners of Philadelphia.

WALTER L. FISK, Jacksonville, Fla.—On duty under the immediate orders of Lieutenant Colonel Gillmore.

Under orders to report to Major Mansfield for duty.

SOLOMON W. ROESSLER, West Point, N. Y.—On detached service; on duty at the Military Academy in department of Civil and Military Engineering.

GEORGE McC. DERBY, Army Building, New York City.—On duty under the immediate orders of Colonel Newton.

JAMES L. LUSK, West Point, N. Y.—On detached service; on duty as Adjutant of the Military Academy; commanding officer of band and field music and Recruiting Officer.

FREDERIC V. ABBOT, Whitestone, N. Y.—On duty with Company A, Battalion of Engineers.

THOMAS L. CASEY, Whitestone, N. Y.—On duty with Company B, Battalion of Engineers.

THEODORE A. BINGHAM, Chattanooga, Tenn.—On duty under the immediate orders of Major King.

Second Lieutenants.

CURTIS McD. TOWNSEND, Whitestone, N. Y.—On duty with Company A, Battalion of Engineers.

GUSTAV J. FIEBEGER, Whitestone, N. Y.—On duty with Company B, Battalion of Engineers.

OBERLIN M. CARTER, Whitestone, N. Y.—On duty with Company C, Battalion of Engineers.

GEORGE W. GOETHALS, Whitestone, N. Y.—On duty with Company A, Battalion of Engineers.

JOHN MILLIS, Whitestone, N. Y.—On duty with Company B, Battalion of Engineers.

JOHN BIDDLE, Whitestone, N. Y.—On duty with Company C, Battalion of Engineers.

EDWARD O. BROWN, Whitestone, N. Y.—On duty with Company A, Battalion of Engineers.

HARRY F. HODGES, Whitestone, N. Y.—On duty with Company B, Battalion of Engineers.

JAMES G. WARREN, Whitestone, N. Y.—On duty with Company C, Battalion of Engineers.

Officers of the Army Detailed for Service under the Chief of Engineers.

A. F. ROCKWELL, Colonel, U. S. A., Washington, D. C.—In charge, under the Chief of Engineers, of Public Buildings and Grounds in the District of Columbia, with the rank of Colonel.

M. M. MACOMB, Lieut. 4th U. S. Art'y, P. O. Lock Box 93, Washington, D. C.—In charge of Geographical Surveys of the territory west of the 100th meridian.

U. S. Civil Engineers.

S. T. ABERT, 1907 Pennsylvania Avenue, Washington, D. C.—In charge of the improvement of the harbors at Washington and Georgetown, D. C., harbor at Breton Bay, Leonardtown, and at entrance of Saint Jerome Creek, Md.

In charge of the improvement of the rivers Rappahannock, Chickahominy, Mattaponi, Totusky, York, Pamunky, and Staunton, Va., Roanoke and French Broad, N. C., and Dan River, Va., and N. C.; of channel in Potomac River through flats in front of landing at Mount Vernon; of Neabsco, Nomini, and Urbana creeks, Va.

In charge of the examination or survey of Staunton River from Brook Neal to mouth of Pig River, Va., Roanoke River from Weldon, N. C., to Clarksville, Va., Potomac and Anacostia Rivers, in vicinity of Washington, D. C., with reference to improvement of navigation, the establishment of harbor-line and raising of flats, so far as their improvement may be necessary, etc., and of survey of Upper Machodoc and Urbana creeks, Va.

In charge of preliminary investigations respecting location, etc., of proposed free bridge over Potomac River at or near Georgetown, D. C.

M. MEIGS, Keokuk, Iowa.—On duty under immediate orders of Captain Mackenzie.

Retired Officers.

Brigadier-General A. A. HUMPHREYS, Bvt. Major-General, 1432 K St., N. W., Washington, D. C.

Colonel THOMAS J. CRAM, Bvt. Major-General, 304 South 19th St., Philadelphia, Pa.

Colonel GEORGE W. CULLUM, Bvt. Major-General, 261 Fifth avenue, New York City.

Colonel JAMES H. SIMPSON, Bvt. Brigadier-General 2 Monroe Place, St. Paul, Minn.

Lieutenant Colonel LORENZO SITGREAVES, 1296 F St., Washington, D. C.

Major FREDERICK E. PRIME, Bvt. Colonel, care Dr. Buell, Litchfield, Conn.

* * *

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 173.

CCCXV.—NEW LISBON, O.

New Lisbon, Ohio, in lat. 40° 50′ N., long. 81° 50′ W., is on the Middle Fork of Little Beaver River, on undulating ground.

Settled in 1802, it was incorporated in 1825.

Water-works were built by the town in 1842, taking the supply from springs, the water from which is conducted half a mile through some wooden and some iron pipe of 4 in. diameter to a reservoir 120 by 250 ft., formed by a stone dam 20 ft. high and 120 ft. long across a ravine. The reservoir holds 2,000,000 gallons, and is 80 ft. above the centre of the town.

Distribution is by 1½ miles of 10, 6 and 4-in. pipe, partly of cast iron and some of wood, with 21 fire hydrants, 10 gates and 24 taps. Service pipes are of wrought iron.

The population in 1880 was 2,028. The consumption is not given.

The works have cost about $30,000, and the receipts have been about $500. There is no record of expenses in 1881, and the receipts were $85.91.

The works are managed by three trustees, one being elected each year.

C. L. Frost is the Secretary.

CCCXVI.—LOCKHAVEN.

Lockhaven, Pennsylvania, in lat. 41° 16′ N., long. 77° 31′ W., is on the west branch of the Susquehanna River.

Settled in 1833, it was incorporated as a city in 1870.

Water-works were built by the town in 1869, after plans of Phaon Jarrett, taking the supply from two mountain streams draining 15 square miles, the water from which is impounded by two dams, making reservoirs which contain 14,580,000 gallons at 183 ft. above the city.

Distribution is by wrought-iron and cement pipe of from 12 to 3-in. diameter. In 1881, lightning struck a horse, followed the service pipe to the main and destroyed 400 ft. of 4-in. pipe. There are 15 miles of pipe, with 60 fire-hydrants, 80 gates and 700 taps. Service pipes are of galvanized iron.

The population in 1880 was 5,846. The daily consumption is not known.

The works have cost $130,000 and the receipts have amounted to $90,000. There is a bonded debt of $70,000 at 6 per cent. interest.

The expenses in 1881 were $1,150, and the revenues $6,500.

The works are managed by a committee of the City Council and a superintendent.

E. A. McGill is the Superintendent.

CCCXVII.—NEW MILFORD, CT.

New Millford, Connecticut, in lat. 41° 34′ N., long. 73° 26′ W., is on the Housatonic River, on a succession of irregular terraces, with abrupt changes from one level to another.

Settled in 1707, it was incorporated as a town in 1712. Water-works were built by a private company in 1874, after plans of W. B. Stilson, taking the supply from a small mountain stream which is impounded by a stone masonry dam, the upper face of which is of brick. A brick filter is built in the reservoir, filled with gravel, sand and charcoal, through which the water passes upward into an open chamber, and thence to a supply pipe of cast iron 6 in. in diameter and 1½ miles long, to the distributing resevoir which contains 2,000,000 gallons at 250 ft. above the village.

Distribution is by cast-iron pipe of 6 and 4-in. diameter, with some 1-in. branches to outlying houses.

There are 4½ miles of pipe, with 32 fire hydrants, 22 gates and 185 taps. The fire district contributes $800 per year for hydrants. Service pipes are of galvanized iron.

The population in 1880 was 1,434. The consumption is not stated.

The capital stock of the company is $25,000. The works have cost $30,036.62 and the receipts have been $18,540.04. There is no debt. The expenses in 1881 were $411.35 and the receipts $2,955.50.

C. H. Noble is the Secretary and Treasurer, and H. O. Warner the Superintendent.

CCCXVIII.—JOPLIN.

Joplin, Missouri, in lat. 37° N., long. 94° 30′ W., is in the centre of the mining region of Southwestern Missouri, on uneven ground. Settled in 1871, it was incorporated in 1873.

Water-works were built by a private company in 1881, after plans of P. B. Perkins, taking the supply from Shoal Creek, which flows 3½ miles south of the town, and rises in the Ozark Mountains 50 miles distant. The water is raised 220 ft. by a pump built by Smith, Vail & Co., into a reservoir holding 1,500,000 gallons, built in embankment and lined with stone laid in cement. It is 82½ ft. above the city.

Distribution is by cast-iron pipe of from 12 to 4 in. diameter, of which 12½ miles are laid, with 60 fire hydrants and 20 gates. The number of taps is not given. There are 5 meters in use. The town pays $5,000 per annum for use of fire hydrants. Service pipes are of wrought iron.

The population in 1880 was 7,038.

The works cost $124,000. The bonded debt is $75,000 at 7 per cent. interest.

L. P. Cunningham is Secretary of the company, and C. J. Lewis the Superintendent.

CCCXIX.—NORWICH, N. Y.

Norwich, New York, in lat. 42° 32′ N.' long. 75° 30′ W., is on the Chenango River at the mouth of Canasawacta Creek. Two high rolling ridges are separated by the valley of the Chenango, one of them rising to a height of 500 ft.

Settled in 1788, it was incorporated as a village in 1816.

Water-works were built in 1881 by a private company, after plans of P. H. Baermann, C. E., taking the supply from a stream of 4 square miles water-shed, called Hopkins' or Ranford's Brook.

An earth dam 40 ft. high, 10 ft. wide on top, and 323 ft. long, with puddle wall in the centre and cross walls of concrete at the base of the puddle wall, forms a storage reservoir 35 ft. deep, holding 30,000,000 gallons at 180 ft. above the village. The water is drawn from the reservoir by a vertical 24-in. pipe, at the base of which is an arrangement of drain tile designed to filter the water, which is thence conveyed to the village through 8,200 ft. of 12-in. cast-iron pipe. Distribution is by 6½ miles of cast-iron pipe of 12 to 4-in. diameter, with 14 fire hydrants, 55 gates and 100 taps. The town pays $36 per year for each hydrant. Service pipes are of wrought iron.

The population in 1880 was 5,000. The consumption is not known yet.

The capital stock of the company is $50,000. The works have cost $70,000.

T. De Witt Miller is Secretary, and Cyrus B. Martin Treasurer.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is acknowledged with thanks: From Cyrus B. Martin, Treasurer, statistics and water rates of the water-works of Norwich, N. Y. From C. E. Fowler, Superintendent, 18th Report of the water works of Poughkeepsie, N. Y. From E. A. McGill, Superintendent, statistics of the water-works of Lockhaven, Pa. From C. L. Frost, Secretary, statistics and water rates of the water-works of New Lisbon, Ohio. From C. J. Lewis, Superintendent, statistics and water rates of the water-works of Joplin, Missouri. From C. H. Noble, Secretary, statistics and water rates of the water-works of New Milford, Conn. From W. W. C. Sites, Chief Engineer, annual report of Board of Public Works of Jersey City, N. J., for 1881.

CORRECTIONS.—May 27, 1882, p. 172.—*Attleborough*, 9th line, for *drought*, read *draught*; 10th line, for *for service*, read *for fire service.*

* * *

A COSTLY BUILDING SINKING.

St. Isaac's, the great cathedral at St. Petersburg, which was finished in 1859 and cost $25,000,000, is slowly sinking into the ground and the authorities do not know how to stop it. The Russian capital is built upon a marsh, and the site of St. Isaac's is on one of its softest parts. Over $1,000,000 was spent in driving piles originally, but the building has never been firm and now threatens to topple over at one corner. A recent examination showed that on one side the columns had separated from the architrave, leaving a space of three inches between. The roof was at once lightened by removing large stones, but new fissures appeared as the work went on, the workmen left in fear and the engineers gave up the job as a bad one. Since then nothing has been done except to hold consultations and reject unpractical plans for saving the building.—*Exchange.*

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GEO. H. FROST......EDITOR AND PROPRIETOR.

JULIUS W. ADAMS,*
Past President A. S. C. E., } ASSOCIATE EDITORS.
S. D. V. BURR............ }

SATURDAY, JUNE 3, 1882.

EDITORIAL ANNOUNCEMENTS.

***Communications** for Mr. Adams should be addressed to Julius W. Adams, care of this journal, New York city. Articles written by Mr. Adams will be signed thus *; and only for articles so signed will be be responsible.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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WE learn from a reliable source that the German government intends to attach architects and engineers of experience to their foreign embassies and legations, to report on new inventions, remarkable achievements, etc., that may come under their notice. An international interchange of thought and experience would be beneficial to all classes.

THE INDUSTRIAL OUTLOOK.

The magnitude of the movement among the workmen to secure higher rates of compensation on declining markets is attracting the attention of more than those who are directly concerned in the exchange of services for wages.

The labor agitations have assumed somewhat alarming proportions, but, after all, the problem involved contains within itself the germs of its own satisfactory solution. That permanent injury can be done to the industrial, transportation and commercial interests of the nation through strikes for higher wages, is, in the long run, practically impossible, as has been repeatedly demonstrated to the terrible cost of the weaker element in such contests. At the present time the iron and steel workers, to the number of fifty thousand, according to estimates made, are in an attitude of rebellion, not against employers but against the laws of trade and forces which control prices and values. It is barely probable that the demands made for an advance of $2.50 per ton in wages, on the present cost of making a ton of iron, at a time when the value of iron has declined from $5 to $8 per ton, will be complied with. Concession may become the least of two evils, as has been seen in iron workers' disputes in years past. Even if so, this fact would obstruct the steady march of values to a lower permanent level, as has been heretofore hinted. The present struggle is entered upon with harmony between all Western manufacturers. They have refused to sign scales submitted to them. The impression exists that one side or the other will give way in a short time. If one, two or three hundred puddling furnaces were thrown idle the restricted production would be beneficial rather than otherwise, but in the present case the number is so great that a scarcity of iron must follow, with a corresponding enhancement of value and price. Demand has declined steadily. A revival of demand would force resumption on the most favorable terms. The labor union whose authority is so widespread in the mills refuses to entertain any suggestion but unconditional surrender. It is not at all surprising that two hundred and fifty million dollars' worth of capital is anxious to escape from the dictation of a power which issues its secret mandates with an iron will, and so resolutely maintains them to the end.

Compensatory influences are at work. Invention is seeking to substitute machinery in iron-making more generally. In time, no doubt, the present tedious and costly methods of iron-making will give place to methods for making steel direct. Much encouraging progress is to be recorded. At present but little economic advantage has been attained; but the possibilities exist for reaping substantial advantages. Increased demand will keep pace with cheapness, and thus affect equal employment at improving rates of compensation, without, as at present, invading the limits of legitimate profits of manufacturers.

One advantage following the declining prices is the increase of requirements. The upward tendency of the past few months, combined with other influences, such as diminished agricultural wealth, decreased volume of available capital, and the like, have checked demand and enterprise and investment. Within a few weeks the tendency to lower prices has brought out many buyers, especially for work required in engineering enterprises. Bridge building is being more vigorously prosecuted. The structural mills have an abundance of orders from the bridge works, and manufacturers report a constant accession of orders for fall delivery. Plate and tank iron are somewhat less active, but there is no scarcity of work anywhere. Locomotive building has not received any set back. Car work is abundant; quite a number of works are making extra time. The demands of the ship and boat yards continue heavy; the foundries and machine shops are crowded with work for the summer. Gas and pipe establishments and works making water-pipe are full of orders. Machinery of all kinds is in extraordinary demand, so much so that for the first four months of the year $265,000 worth of steam machinery was imported because of the inability of domestic concerns to meet requirements promptly. The productive energy of the nation is rapidly gaining ground, and new markets are being sought for our prospective surplus of manufactured products.

The fan-like tail of our industrial prosperity is even now spreading out when one or two of the main branches are suffering. The decline in railway material has not yet had the desired effect of attracting railway builders to the mills because of the lack of other necessary elements. Abundant crops are promised, and this is the chief want. Abundant capital awaits invitation, but the great reserve accumulated by the inactivity of the panic period has been invested and investors are now awaiting returns. Governments are not heavy borrowers, as a few years ago. Hence other channels are sought for. Rates of interest are declining because of the accumulating surplus. The present caution among investors will continue until industrial activity will have sufficiently expanded and the competitive forces have sufficiently reduced prices to afford the needed inducements to plunge into vast industrial and commercial enterprises, some of which are now looming up before the world.

PERSONAL.

A. J. TWIGGS is Chief Engineer of the Augusta & Knoxville Railroad.

C. J. HARDAWAY has been appointed Division Engineer of the Rushford branch of the Tonawanda Valley & Cuba Railway.

G. W. HUGHES has been re-elected Chief Engineer of the Little Rock, Mississippi River & Texas Railroad.

A. M. BANNISTER, C. E., is now engaged on the Guatemala Central Railroad, which will soon be finished to Guatemala.

W. E. TISDALE has been appointed acting Chief Engineer of the Manitoba Southwestern Railway in place of Mr. DAVIDSON, resigned.

DUNCAN MCINTYRE, President of the Atlantic & Northwestern Railway, has left for England, for the purpose of promoting the new railway bridge at Lachine for the Canada Pacific Railway.

THOMAS C. COX.—From a Washington paper of May 26 we take the following:

"Mr. Thomas C. Cox, water registrar of the District of Columbia, died at his residence on N street, West Washington, this morning about ten o'clock, after an illness of some months. He was in the 54th year of his age. Mr. Cox was affected with disease both of the heart and lungs, and the complications were such that it has been thought for some time past that he could not survive. The deceased was a native of Georgetown, being the son of John Cox, who was mayor of that city for many succeeding terms of office. He was Disbursing Clerk in the State department for many years, and while there was sent to England by Secretary Seward on important business connected with that department. He was afterward Secretary to the British-American commission, generally known as 'the High Joint Commission,' which met in this city and he went to Europe with the commission. He was appointed to his present position upon the death of his predecessor, Water Registrar Lubey, a few years ago. Mr. Cox was highly esteemed by his many friends. He was a member of Christ P. E. church, having been confirmed during the rectorship of Rev. W. W. Williams. He leaves a widow and a large family of children. He has a sister, Mrs. Watkins Addison, and a brother, Mr. Richard Cox, living in West Washington. The District Commissioners to-day adopted appropriate resolutions of regret and condolence."

RECENT INVENTIONS.

HEATING RAILROAD TRAINS BY HOT WATER.

This improved device for heating railroad trains by hot water consists of a continuous circuit pipe extending from the fire-box of the locomotive by flexible connections throughout the train, and returning by a separate pipe through the fire-box. The water within the pipes is heated in passing through the fire-box. The pipes through the passenger cars are provided with a series of return bends, each extending under a seat. Back pressure in the water-pipe from the heater toward the tank is prevented by suitable valves. The portions of the pipes which are outside the car are suitably protected.

NOVEL POCKET PHOTOGRAPHING APPARATUS.

A late important invention, which is designed especially for field use, consists of a tripod-head and double plate-holder adapted to be used with what is known as the Walker apparatus. The tripod-head is adapted to be detached from the camera and folded up in very small compass. The double plate-holder, being made of hard rubber, is jointless, and consequently unaffected by moisture. It is by reason of this important invention that it is possible to reduce the dimensions of the camera to pocket size, and also by means of commercially prepared gelatine dry plates for taking instantaneous views. Civil engineers, provided with such an apparatus as this, could obtain important views concerning the topography of the country through which they were projecting railroads, as, by the use of this dry process, it is asserted that no previous experience is required, and that amateurs can secure good results. The complete apparatus is adapted to be stowed away like a field-glass in a pocket slung by a strap over the shoulder. Similar apparatus, as regards size, has been sold before; but I believe no apparatus has been manufactured having regard for such perfection of detail as that made by the Walker Company, of Rochester.

DESULPHURIZING FURNACE.

A late and new process for desulphurizing ores consists of the following successive steps: First, drying the ores; second, subjecting the dried ore in a close chamber to thorough agitation; third, subjecting the ore to the action of heat; and, fourth, injecting hot air, which has been dehydrated or deprived of its moisture. The air, before being admitted to the roasting-chamber, is dehydrated by being forced through a body of common salt.

SIGNALING BY ELECTRICITY.

This electric signaling apparatus consists of a relay, having a movable armature and retractor, and a device for alternately breaking and closing the circuit thereof, combined with a local battery and circuit, for operating registering apparatus, the terminals of which are controlled by the said relay armature, whereby the condition of the local circuit is changed, both at the movement of the relay armature from and to its movements toward the poles of its magnets. A record is thus made both at the opening and closure of the main or relay circuit.

IMPROVED PIPE-JOINT COUPLING.

A late improvement consists of a pipe-joint for coupling pipes at any angle with each other. The coupling proper consists of two hemispherical shells fitting each other, with an annular overlap joint. Each half shell has a pipe opening suitably screw-threaded to receive the adjacent ends of the pipes. In order to keep the hemispherical shells in place, and steam or water tight, a central bolt is provided, passing through the shells. When it is desired to set the pipe-joint at a certain angle this bolt is loosened and the shells adjusted, after which the threaded bolt is again tightened.

A NOVEL LIMB REST FOR RAILWAY TRAVELERS.

This ingenious device has cords attached to the front edge of the seats underneath and running lengthwise of the same. Across the space in front of each seat is a canvas portion about 18 in. wide, adapted to run over the stretched cords. When not in use or unoccupied the canvas can be slid along upon the cords and compressed into a compact condition at one end of two adjoining seats.

AUTOMATIC RAILWAY SIGNAL.

In this improved automatic railway signal the bell-striking train of wheels is set for action by a passing train, and its controlling detent is released through an electro-magnet which is vitalized by a magneto-generator actuated by the passing train.

IMPROVED LEVEE.

This improvement, coming as it does during the wide-spread devastation in the South from the overflow of the Mississippi, is of peculiar importance. Within the embankment are two or more parallel fences or walls, each of less height than the adjoining one from the rear toward the water front, the tops of posts of the highest fence having pivoted levers to be raised when desired, to heighten the levee, to prevent a wash or repair a break. All the walls rest on the ground under the levee and are covered by it.

PROCESS OF MANUFACTURING WATER-GAS.

This improvement in the process of making the gas known as "water-gas," consists in introducing steam together with air at the bottom of a cupola or furnace containing carbonaceous fuel, for the purpose of raising it to incandescence, desulphurizing it, and preventing the formation of clinker, and disintegrating it if formed; and in introducing steam into the generator at or near the top thereof, and causing it to pass in a downward direction through the incandescent carbon.

IMPROVED AUTOMATIC FIRE-EXTINGUISHER.

This fire-extinguisher comprises the following novel elements: The pipe leading from the reservoir has a valve-seat at its outer end, and a distributor secured by fusible solder around the discharge opening. A valve is employed, the stem of which is secured to the distributor, and the body of which is made in part of a fusible material. The fusible material is fusible at low temperatures, so that in the event of a fire in a building in which the extinguisher is located, a fusion of the parts which retain the flow of the fire-annihilating gas ensues.

IMPROVED SNOW-LOADER AND DUMPER.

This improved snow-loader and dumper for use on railroads consists of a car which is provided at one end with an inclosing shield and at the other with a plow and cutters. Pivoted platforms are adapted to be raised and lowered by means of chains secured to cross-beams of the platform, and passing through rigid brace pieces. A breaker, consisting of beams hinged to the shield and joined at their forward end by a knife, is arranged to be raised and lowered to separate the mass from the drift.

APPARATUS FOR UTILIZING SOLAR HEAT.

In this improved apparatus for concentrating and applying the heat rays of the sun consists of a mirror straight in longitudinal direction, and of parabolic or equivalent curve in cross section, adapted to concentrate the heat of the sun's rays on a focal line. A heat receiver mounted on the axis of the mirror is adapted to be used in combination with this mirror.

Washington, D. C. F. B. Brock.

IMPROVED APPLIANCES FOR WORKING UNDER WATER OR IN IRRESPIRABLE GASES.*

History of Diving.—In bringing before the members of this institution the following paper, the author does not intend describing at any length the early history of diving.†

From the earliest times divers have been employed in fishing for pearls, corals and sponges, and have been accustomed, before descending, to place a piece of sponge soaked in oil between the teeth. This is said to have enabled some of the most hardy to remain at least six minutes under water. The records of the earlier attempts to provide some artificial supply of air to divers under water are unsatisfactory. Roger Bacon (A. D. 1240) was supposed to have originated a machine for working under water. The invention of the diving bell is generally assigned to the sixteenth century. The first account of its use in Europe is that of Tasnier, who relates that in 1538, at Toledo, in Spain, he saw two Greeks, in the presence of Charles V., let themselves down under water in a large inverted kettle without being wet. Lord Bacon, in his *Novum Organum* (A. D. 1600) describes the primitive method adopted in his time, in which there was no mode of replenishing the air in the inverted vessel or bell whilst under water. In 1632 Richard Norwood took out a patent for a special means to dive into the sea. Borelli, in 1669, constructed a copper vessel 2 ft. in diameter, with glass fixed before the face of the diver; this he termed a "Vesica." It was worn as a helmet, and securely attached to a dress of goatskin. Within the "Vesica" were pipes, by means of which a circulation of air was contrived. An air pump was affixed to his side, by which the diver was said to condense or rarify the air within the "Vesica," so as to make himself heavier or lighter, on the same principle as the air-bladder of fishes. Artificial webbing was also supplied to the feet, to enable him to tread water. In the latter part of the seventeenth century the diving bell came largely into use. About 1680 a mania arose for undertaking submarine exploration, and companies were formed for that purpose; but from imperfect appliances they were unable to reap profitable results. About the year 1700 Dr. Edmund Halley devoted much time to subaqueous experiments, and in 1716 he read a paper before the Royal Society entitled "The Art of Living Under Water." In this paper he says: "When there has been occasion to continue long at the bottom of the sea some have contrived double flexible pipes to circulate air down into a cavity, inclosing the diver with armor, to bear off the pressure of water and give leave to his breast to dilate upon inspiration, the fresh air being forced down one of the pipes with bellows, or otherwise, and returning by the other of them, not unlike an artery or vein. This has been found sufficient for small depths, 12 or 15 ft., but when the depth surpasses three fathoms experience teaches us that this method becomes impracticable, for though the pipes and rest of the apparatus may be contrived to perform their office duly, yet the water, its weight now become considerable, does so closely clasp the limbs that are bare, or covered with flexible covering, that it obstructs the circulation." To remedy these inconveniences he turned his attention to the diving bell. His contrivance consisted of a truncated cone of wood, 3 ft. diameter at the top and 5 ft. at the bottom, and containing 60 cu. ft. In the top was placed a strong glass to give light, and a cock to let out air. The bell was coated with lead and weighted, that it might sink steadily; when below it was supplied with air by two barrels of 36 gallons each, which were alternately lowered and raised. He states that he remained one hour and thirty minutes under water, at a depth of 10 fathoms. In 1721 he described to the Royal Society a method by which the diver could leave the bell. He used pipes, 40 ft. in length, made with spiral brass wire inside; one end was fixed in the bell, and the other to a cock which opened into the diver's cap. This was made of lead, weighing 56 lbs., and he also wore a girdle of the same weight, and clogs of lead weighing 12 lbs. each. About the same date, 1716, when Dr. Halley read his first paper to the Royal Society, John Lethbridge invented an air reservoir, made of wainscot, perfectly round, and 6 ft. long, 2 ft. 6 in. in diameter at the head, and 1 ft. 6 in. at the foot. He compressed air into this with a pair of bellows, and then lowered it with himself under water, where he remained thirty-four minutes. Numerous inventors followed in his track. Smeaton, in 1779, first employed the diving bell for civil engineering operations, in repairing the bridge at Hexham, Northumberland. The apparatus was an oblong wooden box, 4 ft. high, 2 ft. wide, and 3 ft. 6 in. long. It was supplied with air by a pump fixed on the surface. Soon after the construction of the New Dock at Ramsgate, in 1784, Smeaton employed an improved diving bell weighing half-a-ton; two men worked in it, and were provided with a constant supply of fresh air through flexible pipes, by means of a force pump placed in a lighter which floated over them. Smeaton appears to be the first person who used the air-pump to force a supply of fresh air to the divers, in the bell under water. A diving dress was invented in 1798 by Kleingert, of Breslau, which consisted of strong tin-plate armor, in the form of a cylinder encasing the diver's head and body, with a leather jacket and strong leather drawers. These were made water-proof, and joined by brass hoops around the metal armor, so that the diver was relieved from the pressure of the water except on the legs and arms. He inhaled the air from the surface through one pipe, and the vitiated air was carried to the surface by another. A diver could not with this apparatus descend to greater depth than 20 feet. About the same date Messrs. John and William Braithwaite constructed a diving apparatus with which they carried out several successful operations. In 1805 they recovered £75,000 in dollars from the East Indiaman Earl of Abergavenny. Rennie, while occupied on the works of Ramsgate Harbor, 1813, made considerable improvements in the diving bell; he designed and constructed a diving bell of cast-iron, 6 ft. high, 4 ft. 6 in. wide, and 6 ft. long, with one side a little heavier than the other, so that it should not float quite level, and thus more readily allow the vitiated air to escape. At the top of the bell six thick bull's-eyes of glass were fixed to admit light. In the center of the top was a circular hole, in which a brass lining was firmly fixed. To the under side of this was attached an air valve on a brass grating. The valve itself was simply a disk of strong leather. A nozzle was fixed to the top of the bell above the valve, and to this was screwed a water-tight leather hose 2½ in. diameter, connected to the air-pump, which was constantly worked by a sufficient number of men. Inside the top of the bell were strong lugs, to which were attached chains for suspending stones or other material. The bell was fitted with seats and a rail for hanging the various tools used by the men; it was slung by stout chains from a double purchase crab fixed on a truck, which could travel along the gantry; the total weight was five tons. Rennie used this diving bell with great success in the numerous harbor and other works with which he was associated.

The Open Diving Dress.—In the year 1828 or 1829, the late Mr. Augustus Siebe, A. I. C. E., the founder of the author's firm, was applied to by Messrs. Deane to assist them in the construction of a diving dress, afterwards known as the Open-Helmet Diving Dress. The helmet was made of copper with a screw lens in front, and a metal elbow riveted on the back of the head-piece, to connect the air-pipe with the pumps, the head-piece and breast-plate being in one. To the breast-plate was attached a canvas jacket, which, with the aid of two lead weights, kept the helmet fixed upon the shoulders. Boots with lead soles, weighing 12 pounds each, were worn, and also a water-proof dress fastened round the neck, over which were placed the helmet and jacket. The air escaped into the water from underneath the outer canvas jacket, and the water reached within a few inches of the diver's mouth, so that he had to work in a vertical position. The air-pumps had three cylinders, 8-in. diameter, 9-in. stroke. Even at the present day many of the coast divers use this form of dress.

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* Paper by W. A. Gorman, read before the Institution of Mechanical Engineers, London, April 20, 1882.

† Those who take an interest in the subject are referred to Lord Bacon's *Novum Organum*; *Philosophical Transactions*, from the time of Halley, 1678; *The History of Inventions*, by Beckman; Boyle's *Experimental Philosophy*; the article on Diving in *The Encyclopædia Britannica*; and Messrs. Siebe & Gorman's book on *Diving*.

The Close Diving Dress.—About 1889, when engaged at the wreck of the Royal George, Mr. Siebe, observing the danger attending the use of the open helmet, introduced his invention of the close helmet, fitted with inlet and outlet valves, and with segmental neck screw, to remove the head-piece by one-eighth of a turn. The water-proof dress was fastened to the metal collar by screws and brass bands. Colonel Pasley, R. E., (afterwards Major-General Sir C. Pasley), at once ordered the Royal Engineer divers to be equipped with this dress and helmet, and the operations at the wreck, owing to this great improvement, were carried on with much greater rapidity and without accident.

The above brief description of diving apparatus in its primitive form will be sufficient to show the progress made up to a recent date.

Modern Apparatus.—This apparatus is a very perfect one, combining a high degree of safety with comfort for the diver. The air-pump is capable of compressing air to a pressure of 240 lbs. per square inch, and consists of two vertical double-action gun-metal cylinders, securely fixed to a bed-plate of gun-metal, which is bolted on the base of two side standards forming an iron framing to carry the crank-shaft. Each piston is constructed of two inverted cups of leather, with leather packing placed between, and the whole is secured by two cast-iron piston-plates fitted to the piston-rod inside the leather cups, and pressed together by a nut. Grooves are formed in the periphery of the piston-plates, to contain expanding springs, which, pressing against the inner side of the leather cups, keep them in close contact with the cylinders, and thus maintain the piston in a perfectly air-tight condition. Each cylinder cover has an oil tap for lubrication. The piston-rods pass through glands packed with turned leather washers, and are extended so as to work in guides. Double connecting slings, with gun-metal bearings, connect the piston-rods to the crank-pinks. Inlet and outlet valves are fixed in the covers of each cylinder, and also in the base plate. Spindle valves are used, faced with leather, and with gun-metal seatings, to which the valve is kept by a spiral spring. The top and bottom outlet valves are connected by passages cast on the cylinders, and leading to the air-delivery nozzle. The cylinders are surrounded by a copper cooling cistern.

Pressure gauges show the depth and pressure at which the diver is working, and are also used for testing the air pipes. Each gauge is marked off to represent the pressure in pounds per square inch at given depths of water, as given by the following table:

Depth. Feet.	Pressure. Lb. per sq. in.	Depth. Feet.	Pressure. Lb. per sq. in.
20	8.68	120	52.08
30	13.02	103	56.42
40	17.36	140*	60.76
50	21.73	150	65.10
60	26.04	160	69.44
70	30.38	170	73.78
80	34.72	180	78.12
90	39.06	190	82.46
100	43.40	204†	88.54
110	47.74	....	.....

* Practical limit of diving.

† The last figure is the greatest depth to which (to the author's knowledge) a diver has ever descended.

The fly-wheel and winch-handles, fitted on the crank-axle, are made to be easily removed, and the whole pump is securely fitted in a strong teak case. The author then described the air-distributing arrangement, by which the air can be transmitted to one or two divers as occasion may require. The water-proof dress is made of strong tanned twill, with an india-rubber lining between the thicknesses of the material. It has mineralized india-rubber collars and cuffs. The boots have lead soles weighing 14 lbs. each At the front and back are lead weights 40 lbs. each. An air-pipe with spiral wire embedded in it, and joints fitted to connect up to any desired lengths; a knife, in watertight case, a leather belt and pipe holder, and a double suit of flannels, complete the equipment. For deep water the men wear a body guard to keep off the pressure.

Experience in Working.—Some special cases of diving with this apparatus may be mentioned. In the recovery off treasure from the Hamilla Mitchell, sunk off Shanghai, in a depth of 144 ft., the diver, Robert Ridyard, worked for five consecutive days, five to six hours each day, recovering £40,-000 in dollars. The apparatus was used constantly day and night at the raising of the Eurydice. On an average eight divers were working together in a strong tide and amongst wreckage, but not a single accident occurred. When the news reached England that H. M. S. Doterel was blown up, the Admiralty at once telegraphed to the ships of war on the station to proceed to the scene of the disaster, as each of H. M. ships carries a seaman diver and also an artificer diver. H. M. S. Garnet was the first vessel to arrive at Sandy Point. Lieutenant Stanley Dean Pitt, R. N., volunteered to accompany George Hunt, artificer diver, in making a careful survey of the wreck, which was lying in 12 fathoms of water, the result being positive proof that the boilers had not caused the explosion, as they were found in perfect condition. The author considers that the apparatus he has described was in this particular case of great service in the engineering world, to say nothing of the importance to the country, as the whole of the armament and other valuable property were recovered. For engineering works the apparatus is in use at the present time to a considerable extent, as at Colombo, Port Elizabeth, Madras, and many other barbors. The average number of hours for a diver to work in water, say to 60 ft. depth, is four. Their pay depends upon their capabilities; but in this country the average rate is £4 10s. per week for masons, £4 for carpenters, and £3 10s. for laborers. In wrecking operations the divers work at a salvage scale, according to the depth, and as a rule earn very good wages. As so many various handicrafts are required for submarine works, the author's firm have erected a diving tank in their works, where men are trained, and also experiments carried out. The selection of divers requires much care. Steady habits are essential, and from long experience it is found that men of sanguineous temperament are unfit to bear great pressure, while a man slightly built but muscular, although he may seemingly be weak in lungs, often turns out a first-class diver, and improves in health and strength. Among the many purposes for which the diver is required may be mentioned the following: The repairs and inspection of dock gates, sluices, bridge foundations, etc.; the removing of pumps and other appliances in shafts; the repair of well pumps when under water; the cleaning of iron ships' bottoms, and repairing of leaks; the examining or repairing of fouled or damaged screws, etc.; the sinking of cylinders for piers and bridges; the laying of pipes for gas and water in rivers or harbors; torpedo service; and lastly, fishing for sponge, pearl, coral and amber.

Appliances for Working in Irrespirable Gases.—The Fleuss apparatus represents a great improvement in this direction. It is self-contained and entirely independent of any communication with the outer atmosphere, thus enabling the wearer to breathe with safety in the most noxious gases, to walk any distance, and to explore the most intricate turnings of a mine with perfect freedom of action. The principle of the apparatus is that the wearer breaths same air over and over again, the carbonic acid being absorbed from it after each expiration, and at the same time the requisite amount of oxygen restored; thus rendering it pure, and fit to be again inhaled into the lungs. The apparatus consists of a strong copper cylinder 6½ in. diameter, and 12 in. long, with domed ends, and capable of containing 4 cubic ft. of oxygen, at 16 atmospheres' pressure; this being sufficient for four hours' respiration. Above the cylinder is attached a square metal box, 12 in. by 12 in. by 4 in.; this contains the carbonic acid filter, which is a box of vulcanite divided into four compartments by vertical diaphraghms, in such a manner that the exhaled breath of the wearer is made to pass twice up and down through the vessel, before it is in a position to be again inhaled. This box is fitted with small cubes of india-rubber sponge, saturated with a thick pasty solution of caustic soda. The exhaled air, being finely divided as it passes through the interstices of the sponge, and coming in contact with a very extended surface of caustic alkali, becomes thoroughly cleansed of all the objectionable products of respiration. A flat bag of vulcanized India-rubber, 12 in. by 15 in., is strapped on in front of the wearer, into this the exhaled air passes from the filter, by means of a tube of india-rubber. The bag is also in communication with the oxygen chamber, and the supply of oxygen to the bag is regulated by a jamb screw-valve, under the control of the wearer. The mask is made to fit air-tight to the face of the wearer, and is held in place by straps buckled at the back of the head. A band of rubber is made to cover the ears, and the eyes are protected by glass when it is necessary to go into smoke or gases that would hurt them. The mask is provided with a pair of flexible tubes with valves, the one for exhaling being in communication with the filter and the one for inhaling being connected to the air-bag. The slightest effort of inspiration brings the revivified air freely to the lungs of the wearer. The whole apparatus weighs 26 pounds and can be adjusted in two minutes. The author considers this apparatus particularly adapted for the use of coal mines, or when men have to deal with noxious gases. Mr. Fleuss has remained in the densest smoke, as also in a glass chamber charged with carbonic acid, for a considerable time. His apparatus was regularly used for some time at the Westminster Aquarium, and also more recently at the re-opening of the Maudlin seam of the Seaham colliery after the fatal explosion in September, 1880. The author has to thank Mr. Fleuss for his kind permission to bring his improvements before the notice of the Institution. In conclusion, the author may allude to the use of the electric light for submarine purposes. It is really the only light which can be of use to the diver, and of late the author has made some very satisfactory trials of it. The telephone has not been fully tested in practice, the divers preferring their ordinary signal line, or communicating by a slate. The author added that since the paper was written ten lives had been saved at the Killingworth Colliery by means of the apparatus. The appliance was also used at the opening of the Maudlin seam of the Seaham Colliery.

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NEW YORK WATER RATES.

We have just received one of the most extraordinary circulars that has ever reached our office, and one which illustrates better than any other document we have ever seen the absurdity and inconsistency of the present method, so widely adopted in all American cities, of charging and collecting tariff for the use of water. The pamphlet in question is issued by Mr. Hubert O. Thompson, Commissioner of Public Works, and is entitled "Regulations Establishing a Scale of Water Rents for the City of New York." This city is in a most peculiar condition. Served entirely by one large and expensive aqueduct, wastage has increased so rapidly that long before the time expected the city has been taking all the water the aqueduct is capable of bringing. Consumption, if we may dignify the wicked waste by such a name, is so near the capacity of the aqueduct, and the storage supply in the city so small, that it is exceedingly difficult to find sufficient time during the year to make those repairs which are absolutely necessary.

In spite of the cry which went up a few years ago about the waste caused by factories, steam boilers and the hydrants upon the wharves, it has been found, since that waste was partly decreased by the application of meters, that the general waste still goes on, and that the consumption has not diminished practically. Experience has proved that, contrary to the opinion of former commissioners, private houses and places where meters are not put are the great wasters. Few people familiar with the habits in New York houses will be willing to say that in this class of water users wasting is not the rule rather than the exception. In the lower parts of the city, where hopper closets are employed, we should judge, from our own experience, that 90 per cent. of them run continually. The quantity which they waste can well be imagined when we find that, with a 20-foot head, an ordinary basin cock will pass over 1,500 gallons in 24 hours, and this, too, when running a silent stream. New York's population has been steadily increasing, and the opening and addition of large suburbs to the city has called for a large increase in the distributing mains. Looking at the question from any light we may, it is impossible to see how, even in a large manufacturing population, 100 gallons of water can be used per day for every inhabitant.

We think the Croton Department could easily disprove the theory that manufactories are the great water wasters if they would give us the number of gallons manufactories use and the number of gallons which the aqueduct brings to the city. Threatened as the city has been on so many different occasions with a water famine, the necessity of taking measures to avert it has become imperative, and the regulations to which we have alluded are made evidently with the purpose of accomplishing this. One of the great absurdities of them is found in the fact that they attempt to sell a valuable commodity without measurement. It is as though the butcher or grocer should charge different families according to the number of persons in them, and not by the weight of meat which they order. By the new regulations, bakers, for example, are charged according to the amount of flour which they are supposed to use; private stables are charged according to the number of horses kept in them, and after this charge has been paid the owner is at liberty, by the very nature of the contract, to waste as much water as he chooses, provided he does it in a quiet and private way. Even if it is used legitimately, one man is very likely to require twice as much water as another. If the question is transferred to any other article of use, the absurdity and injustice of such a regulation will be seen at a glance.

The regulations which are laid down are of such a character as to put a premium upon wastage. How great this wastage is can easily be imagined when we begin to figure up in barrels the quantity of water used per day, which amounts to enough to fill three ordinary petroleum casks every twenty-four hours for every man, woman and child in the whole city—a quantity far beyond the actual use of any household in the world. Among the regular rents for water we find that, for a house having a frontage width of 16 ft. and under, the charge, if the house be one story in height, is $4; if two stories, $5; from 16 to 18 ft. in width the rent is $6, and from 18 to 20 ft., $7. This is not unlike charging a man at a restaurant for his dinner according to the length of his shoe. The man who wears a No. 9 shoe and is 6 ft. high would have to pay 50 cents, while the man who gets into a No. 7 shoe and is only 5 ft. high would have a 35 cent check. While the 16-ft. front pays $5, the 50-ft. front has to pay $15.

After going through a long list of absurd regulations, absurd simply because they take no account of the quantity used, but simply some size, or number or proportion, which is supposed to bear a relation to the quantity, we get to certain regulations applying to private houses. Here the absurdity becomes simply injustice. Any form of hopper "supplied directly from the Croton, through any form of the so-called single or double valves, hopper-valves, stop-cocks, self-closing cocks, or any valve or cock of any description attached to the closet," is charged per year $20. A hopper of the ordinary kind, with its constantly running valve, certainly ought to be charged $20, but where the hoppers are provided with self-closing cocks of approved pattern and well-tested design, which do not leak and cannot be said to run constantly, to charge such a rate is a very great injustice, for we find that any form of hopper or water-closet supplied from the so-called waste-preventive cisterns, "approved by the engineers of the aqueduct," is charged at only $2 per year. The same manipulation which will cause a self-closing cock of the kinds we have alluded to to run continuously, will enable these waste-preventing systems to do the same thing. After discriminating so against the hopper, the pan closet is charged only at $10 per year when supplied in a similar manner. These regulations also discriminate, we had almost said intentionally, against some of the best and most economical forms of cistern closets that are in the market. It is useless for the Commissioner of Public Works to attempt to prevent the waste of Croton water by specifications of any particular forms of water-closet apparatus. It is equally useless and futile for him to charge an outrageous price for water which is to be supplied in a particular form of water-closet which is considered unusually vicious. People will pay the extra charge, but will grumble and waste more water than the charge would cover.

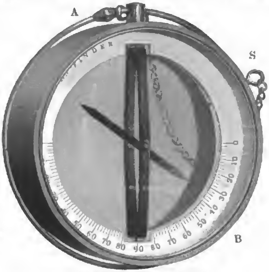
The absurdity of these charges may be seen by stating the case in this way: $20 is the rate charged for water-closets and urinals where the valve is of a character to allow a continual flow of water, and yet this sum is sufficient to pay for a water meter. We only happen to have a single water-meter circular before us. It is that of an approved style, *which has* been in use for 25 years or more and has been well tested. From it we find that a ⅝-inch meter, or one suitable for a ⅝-inch pipe, will cost $17, or $3 less than the charge per annum. This meter is able to supply water in ordinary private houses, and would do what ought to be done, and enable the charge to be made proportionate to the quantity of water used. We might overlook the absurdity of this method of ascertaining the consumption of water, if it were not for the fact that the Commissioner virtually says that only one style of closet shall be used. Practically, the house-owner finds he can only use the closet approved by the Commissioner, where there are many others equally good, and several decidedly better in every respect.—*The Metal Worker.*

AMERICAN SECURITIES.

I see it is stated in several newspapers that American "Rails" have gone up, owing to purchases by English investors. Nothing can be more contrary to fact. At the present moment the American market is overstocked with securities. The old stocks have been pushed up to a very high level, and those connected with new undertakings are in the hands of syndicates and speculators. In the United States investors are perfectly aware that prices must come down, and therefore they do not buy. In England they have also somewhat tardily arrived at the same conclusion, with a similar result. Purchases, therefore, on both sides of the Atlantic are limited to speculators. They buy because they fancy that the great capitalists will combine in order to cause a general rise of prices, whilst the great capitalists encourage this opinion in order that they may sell the securities with which they are overstocked. The trick of these latter is to offer to buy enormous amounts of a stock at two or three per cent. above the current market price of the day. As they know that the stock could not be delivered, the offer is a perfectly safe one to make. Mr. Gould and Mr. Vanderbilt are now acting together. With their great command of cash they can rule the market. But, as I have said, their object is to sell, so as to get rid of the stocks which they hold at a profit. All telegrams, all devices, and all prices from America, must therefore be distrusted just now. When once the great capitalists have managed to wriggle out of their stocks, they will inaugurate a counter movement, and prices will very likely fall as much below intrinsic value as they are now above it. English investors must never lose sight of the fact that the great American fortunes have been made by their owners playing against the public with cogged dice. For my part, I do not believe—speaking generally—that any investor is wise who buys a single share of an American railroad. Of course he may make money by doing so, but he is entirely in the hands of knaves, who command the railroad, who can regulate rates as it suits them, and who are rather less honest than the professors of the three-card trick on our race-courses, although more wealthy.—*Truth (London).*

THE NEW MERIDIAN FINDER.

The accompanying engraving presents an accurate representation of this new compass, and is so clear as to scarcely need any description. In use it is held by the suspension ring *A*, and the needle released from its fixed position by drawing away the stop *S*, the object of which is to prevent oscillation when the needle is not in use. The released needle will attempt to find its true magnetic meridian, and in doing so, should it come in contact with either of the two glasses used as protection from the weather, it is only necessary to turn the case until the needle revolves freely, without touching either of the glass covers: the needle will then point in the direction of the true magnetic meridian.



The New Meridian Finder.

The needle has a motion in azimuth as well as in altitude, and is, therefore, sure of finding its own true magnetic meridian. The needle is so suspended that nothing interferes with its making a complete revolution, so that the all important and final test of reversion can be applied to prove its accuracy.

The New Meridian Finder Miners' Compass is manufactured and sold by the patentees, Messrs. W. Gardam & Sons, 96 John street, this city.

HYGIENIC EXHIBITION AT BERLIN.

A general German exhibition is to open at Berlin on the 1st June next, devoted to objects and methods relating to hygiene and life-saving. It has been organized by the two leading German health societies, and especially includes Germany, Austria, and German Switzerland, though other countries are not excluded. The Empress Augusta has conferred her patronage on the undertaking, of which Herr Hobrecht, Minister of State, is president. The guarantee fund amounts to 200,000 marks (£10,000). Exhibits will be classified according to their practical application, and not their origin; they are divided under (A), hygiene, and (B), life-saving, which again are sub-divided into (1), material objects; and (2), the plans, specifications, regulations, statistics, etc., relating to them. In the various groups occur the following: Boring machines; methods for consolidating roads; appliances for cleansing streets; sewers and their dependencies; water supply; public illumination; electric lighting; gas works; markets and slaughter-houses; baths, washhouses and laundries; private dwelling houses; buildings for the residence of a large number of persons and for public assembly, with their lighting, heating and ventilation; factories and laboratories; electric railways; the heating of towns for a central point; drainage of marshes and irrigation; regulations as to buildings; means tending to improve the condition of the working classes; State supervision of factories; methods for diminishing the inflammability of timber; the prevention of floods; protective measures for land transport, and the prevention of accidents by machinery.

Berlin, May 12.—A fire broke out to-day in the hall of the Hygienic Exhibition, near Moabit, in the district of Potsdam. The building, which was constructed of wood, was soon burned to the ground. The exhibition was to have been opened on Tuesday next, and many costly exhibits were already in place, all of which were destroyed. The flames spread to and swept away several timber yards adjoining. An explosion of gas in a café on the south side of the building caused the fire. The loss is estimated at several hundred thousand pounds. The Emperor William came from Potsdam, and was on the ground during the height of the conflagration. No lives are known to have been lost.

CHECKING THE WASTE OF WATER.

Mr. Greenough, of Ward Nine, from the Committee on Water, made a lengthy report to the council yesterday on the subject of the waste of water and the measures necessary to be taken to prevent the same. At the present rate of consumption, which averages 95 gallons per head each day, the entire capacity of the water-works, including the additional supply to be received from the new basin now being built in Ashland, will be reached in 12 years, while if the rate of consumption could be reduced to 60 gallons per head daily (which amount is regarded as a liberal allowance), the capacity of the water-works would not be reached until the year 1900, and the city would also save $3,000,000 which it will be required to expend to enlarge the system unless the waste is prevented. As showing the amount of water consumed as compared to other cities, the committee cite the following cases:

	Gallons.
Brooklyn	54.2
Cincinnati	75.9
Cleveland	63.6
St. Louis	72.1
Liverpool	27.0
Glasgow	60.0
Providence	36.3
London (average of nine companies)	27.5

The principal reasons for the waste of water are defective mains and services, defective fixtures in buildings, bad plumbing and willful waste. The remedy for the waste was the meter system, house-to-house inspection and the waste-water meter system, and to carry out the conclusions of the committee the passage of the following order was recommended:

Ordered, That the City Treasurer be authorized to borrow, under the direction of the Committee on Finance, the sum of $125,000, the same to constitute a special appropriation for the purchase and attachment of water meters; $100,000 to be expended by the Water Board in purchasing recording meters, and $25,000 to be expended by the City Engineer, under the direction of the Water Board, in purchasing and attaching waste-water meters.—*Boston Journal, May 26.*

CONCERNING MILL DAMS.

Waterloo, Iowa, was several weeks since the scene of a rather interesting trial of a mill dam case, in which the expert testimony called in testified upon the question of how high a dam could be erected below the present structure without backing water up on the tail races of the mills using the present power, and whether a structure designed for a low stage of water, and not interfering with the present power in times of low water, would interfere in high water.

Prof. Philbrick, of Iowa University, testified in behalf of the owners of the present dam and C. B. Davis, C. E., of the Madison Water-works, and A. D. Conover, professor of civil engineering, Wisconsin University, were called in to advise the new company as to the proper height for their proposed dam, and to testify in defense of their advice before the court.

The trial lasted four days, and the time was consumed chiefly in taking evidence. The judge, after hearing an hour's argument from each attorney, rendered decision without leaving the bench, granting to the new company all the privileges they asked for.

ENGINEERS' SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.

Record of Regular Meeting.—May 20, 1882.—Vice-President Percival Roberts, Jr., in the chair. Twenty-seven members and five visitors present.

Mr. T. M. Cleemann read a paper on the "Most Economical Height of Bridge Truss." He said that in most cases of bridge design, after the span was fixed, the height of the truss was only governed by the judgment of the engineer, who generally assumed a proportion derived from some previously constructed bridge. It is not difficult, however, to find the most economical height, and the method, applied to a Howe bridge, was explained, and the result of a similar application to one of the largest iron bridges heretofore constructed likewise stated.

He also continued some remarks that he had previously made on the strength of wrought-iron columns, especially discussing certain experiments which had been lately made at Watertown, with the formulæ that had been proposed to represent their strength.

The latter paper was discussed at some length by Messrs. H. Constable, Strong, Hanpt and P. Roberts, Jr.

Mr. Geo. S. Strong gave an interesting illustrated description of experiment in the application of his Feed-Water Heater to locomotive engines, and also described new devices of his invention, for the piston and connecting rods of locomotives and for a spark-arrester.

Various favorable communications were read from members of Congress in reply to the communication of the club urging the passage of House Bill 4,726.

HOWARD MURPHY,
Secretary and Treasurer.

THE CIVIL ENGINEER.

Well may they sit and banquet, who show the rule of man,
O'er earth and sea, who with the bridge the rolling waters span,
Who tunnel underneath the sea, who climb like mountaineers,
Who drive the great sea-eagles—the gallant Engineers.

They combat Nature's forces, and earth, and sea, and air,
Find men to bend them to their will who labor everywhere;
They bring the lightning from the sky to grace our chandeliers,
And plough the furrows of the sea—the able Engineers.

Then here's a health to Armstrong, and each engineering star,
To Fraser of the Woolwich guns, those mighty babes of war:
They civilise in times of peace, and aid when strife appears,
The Titans of our modern times—our Civil Engineers.
London Punch.

COPYING DRAWINGS.

Tilhet's method of copying drawings in any desired color is thus described in the *Polytechnisches Notizblatt*: The paper on which the copy is to appear is first dipped in a bath consisting of 30 parts of white soap, 30 parts of alum, 40 parts of English glue, 10 parts of albumen, 2 parts of glacial acetic acid, 10 parts of alcohol of 60° and 500 parts of water. It is afterward put into a second bath, which contains 30 parts of burnt umber ground in alcohol, 20 parts of lampblack, 10 parts of English glue and 10 parts of bichromate of potash in 500 parts of water. The papers are now sensitive to light, and must therefore be preserved in the dark. In preparing paper to make the positive print, another bath is made just like the first one, except that lampblack is substituted for the burnt umber. To obtain colored positives, the black is replaced by some red, blue or other pigment.

In making the copy, the drawing to be copied is put in a photographic printing-frame, and the negative paper laid on it, and then exposed in the usual manner. In clear weather an illumination of two minutes will suffice. After the exposure the negative is put in water to develop it, and the drawing will appear in white on a dark ground; in other words, it is a negative or reversed picture. The paper is then dried and a positive made from it by placing it on the glass of a printing-frame, and laying the positive paper upon it and exposing as before. After placing the frame in the sun for two minutes, the positive is taken out and put in water. The black dissolves off without the necessity of moving it back and forth.

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THE CORINTH CANAL.

The King and royal family of Greece were present on the 4th at the turning of the first sod of the Corinth Ship Canal, which will considerably shorten the voyage for vessels trading between the West and the Ægean and Black seas. A grand marble column is to be subsequently erected in commemoration of the ceremony. In cutting the first sod, King George used a silver spade, while the Queen fired a train of 47 dynamite mines, which removed some of the rocks projecting on the line of the canal.

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OUR BURNT OFFERINGS.

According to statistics collected by the *Insurance Chronicle*, the losses by *reported* fires in the United States in the past six years amount to $430,840,300, and in Canada $56,710,300, the total being equal to the capital invested in our national banking system. It is stated that nine-tenths of this loss could have been prevented by care and precaution.

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NOTES.

THE IRON MOUNTAIN OF DURANGO.

The almost fabulous accounts which reached us a short time since of the enormous iron mountain near the city of Durango, Mexico, are, after all, not so very exaggerated as they appeared to be on first impression, for there is a good, solid substratum of truth in them. We have it on the authority of a trustworthy witness. Mr. J. Birkinbine, the secretary of the United Association of Charcoal Ironworkers, who recently made a professional visit to the now celebrated mountain, that it in reality forms a great mineralogical wonder. The Cerro de Mercado, the mountain in question, rises north of Durango, not two miles from its plaza, from the plateau to a height of 600 ft., its length being a mile, its width a third of a mile. Mr. Birkinbine says: "Nothing which I have seen, either in the Lake Superior or Lake Champlain regions, in Alabama or in Missouri, compares with it for magnitude, and even our Pennsylvania Cornwall is small when placed beside it. Several estimates of its cubical contents have been made, all running into hundreds of millions of tons. I have spent three days climbing its steep sides and looking up at its precipitous faces of ore, and feel safe in the assertion that the loose boulders and stones, which everywhere cover the surface, would produce one million tons of pig iron or more. Should the interior of the mountain be composed of as solid ore as the vertical faces, rising like turrets from the slopes made by detritus from them, an estimate of this deposit is beyond our appreciation, for ore was found far below the surface in sinking for an artesian well. There are several problems in the formation which present a surmise to the structure, and here I venture no estimate of the quantity of ore available. It is, however, beyond doubt ample for immense industries, and analyses published of it show remarkable richness and superiority." It is a strange commentary on the absence of metallurgical enterprise in this rich mineral region—gold, silver, mercury, tin and lead being also found in the district—that, under the shadow of this great iron deposit, at Durango, nails should sell at 25 cents per pound, castings at 12½ cents per pound, and a pair of iron-tired cart wheels with iron axle for $125.

THE BASIS OF PROBABILITIES.

Life insurance men know that while nothing is more uncertain than the life of a single individual, the average lives of a thousand men can be calculated with almost absolute certainty. Analogous to this is the regularity of other phenomena, when taken in reference to sufficiently large numbers. While there is, of course, no way of producing such a result, there is born in this city, for example, about an equal number of males and females. If a pack of cards is shuffled at every drawing, and a million of cards are drawn, one after each shuffling, the number of black-spot cards drawn will almost exactly equal the red-spot cards drawn, however often the experiment may be tried. In a city like New York, the number of births each week is nearly equal, and the same is the case as to the deaths, unless there happens to be an epidemic. In the post-office the number of letters delivered each week is so nearly the same as to fill the mind with astonishment. In a great hospital the number of patients each week is nearly the same the year round, and the diseases — such as consumption, pneumonia, typhoid fever, etc.—are very nearly the same from year to year. The number of articles left in cars, omnibuses, and public vehicles, incredible as it may appear, are so near the same number from week to week that the result is simply wonderful. The crimes committed during a year, as the criminal statistics show, are nearly the same in number each year. Accidents happening in the public streets, which would seem to be dependent on no law known to us, reproduce themselves with a like accuracy as to numbers from month to month. Ten weeks' accidents in the streets, taken at random from the official reports of Paris, give the following results: 48, 48, 50, 58, 41, 47, 49, 50, 52, 44. Who can tell the reason of such similarity of events from week to week and from year to year? In the sciences and in the arts when a series of facts are given, it is pretty certain that the causes producing or governing them can be discovered; but such is not the case in regard to the facts such as we have mentioned. The certainty of these results have caused thoughtful men to try and utilize these unknown principles in speculation and gambling. In other words, by studying and following the results of chance which they have spent years in recording. If such efforts have proved successful the result has not been made public. Such facts as we have stated are well worthy of investigation by the learned, as no law has yet been discovered to which they can be referred.

THE EARLY HISTORY OF GAS-LIGHTING.

It has been known for many generations that sometimes coal-seams yield a combustible gas. In the neighborhood of Wigan, England, during the latter part of the seventeenth century, a Dr. Clayton observed gas issuing from the ground, and from the Philosophical Transactions for the year 1677 we learn that Mr. Shirley made some experiments on the production of gas from coal, obtaining what he describes as "black oil" and a "spirit," evidently meaning coal-tar and gas. Much more satisfactory reports of similar experiments are given in the chemical essays of Dr. Watson, published during 1767, by whom, in the report of an experiment on this subject, we are told that from ninety-six ounces of Newcastle coal he obtained twelve ounces of water and gas-tar; twenty-eight ounces of "air" or gas, and of coke fifty-six ounces. A few years later, Earl Dundonald tried experiments in gas-lighting at Culross Abbey. It appears, however, that these experiments on the distillation of coal were made for the production of tar. The Scotchman, William Murdock, is considered the real inventor of gas illuminating. In 1792, he lit his workshop at Redruth, Cornwall; and in 1802, the first attempt on anything like an extensive scale of illumination was established at the manufactory of the renowned Boulton & Watt, Soho, near Birmingham. While this was taking place in England, and probably without any knowledge of it, a Frenchman named Lebon succeeded in lighting a house in Paris with gas. Other works followed the example of Soho, a Manchester cotton-mill being the next, in 1804. In the year 1807, a German named Winsor used gas to light Pall Mall, and five years after he originated the first gas company, "The London & Westminster Chartered Gas-Light and Coke Company," while the French did not adopt this method of public lighting until 1820.—*Engineering and Mining Journal.*

THE ENGLISH CHANNEL TUNNEL.

Much fear has been manifested that the tunnel might, after having been completed, serve as a highway for invading forces from France, and to comfort the timid ones Dr. Siemens lately presented to the Military Committee on the subject of the Channel Tunnel a plan of defense against invasion. He proposes to place a tube just above the lateral drainage tunnel, terminating on the tunnel side in a double arch, with numerous perforations into the tunnel, and on the land side in several chambers of wrought iron sunk into the ground. These chambers he proposes to fill with lumps of common chalk and to connect each of them by means of a pipe with a large cistern filled with dilute muriatic acid. Upon opening the communication this acid would flow into the upper portion of one of the chambers, where it would be distributed by perforated pipes over the entire area. The result of such an inflow would be a powerful chemical reaction, giving rise to a generation of carbonic acid gas, which would for half a mile or more form an insuperable barrier in the passage of human beings through the tunnel. The valves by which the acid was turned upon the chalk might be worked from a safe distance by electricity. Dr. Siemens stated that by the adoption of the scheme the tunnel would be left intact and fit for use after a reasonable interval for proper measures to clear it from the carbonic acid gas.

ELECTRIC LIGHT VS. GAS.

The controversy as to the respective cost of gas and the electric light, if it has not been definitely settled, is, we think, on the road towards solution. The figures now vouchsafed to us by the city authorities may, we take it, be relied upon. We learn that at the meeting of the Court of Common Council held last week Mr. Felton, chairman of the Court of Sewers, stated that, of the three electric lighting systems now being tried experimentally in the city, that of the Brush was about the same price as gas, the Lontin was twice the cost, and the Siemens nearly four times the cost. The Brush patentees had, however, given notice to increase their contract price 10 per cent., and the Siemens authorities also contemplated increasing their estimate to five times the cost of gas in the same area. As to the new effective gas lighting in Fleet Street, he might state that it was over four times the cost of the Brush system in the same district. In reading the above business-like statement, we arrive at two conclusions. In the first place, the effective mode of lighting up the city by arc lamps is nearly as cheap as the indifferent illumination produced by gas. In the second place, it is equally certain that, if gas-light is to be as effective in the open air as the electric light, its cost will be at least three times that of, say, the Brush light. It must, however, be admitted that the latter is the best and cheapest arc light we have at present, its superiority and consequent cheapness being principally due to the excellent quality of the carbons used by the company which owns the light.—*Iron*, April 7.

OUR PLAT AND PROFILE BOOK.

THE following from a Waxahachie, Texas, correspondent, with an order for several additional copies, is but one of many similar notes of approval received:

"The Plat and Profile Book, ordered some time since, came safely to hand. It is just the thing needed; convenient in size, form and style."

J. A. G. W., H. & T. C. Ry. Eng. Corps.

SANITARY APPLIANCES IN PARIS.—As now provided for, Paris claims to have the benefit of the best devised system of sanitary appliances to be found in any city in Europe. The scavenging plant, under this new arrangement, is kept in a central depot, where materials of every description are stored and classified for ordinary and extraordinary service. Among these sanitary supplies are chloride of lime, sulphate of zinc, sulphate of iron and carbolic acid as disinfectants, and hydrochloric acid and nitro benzole as cleansing agents. Chloride of lime is used of a strength of one hundred to one hundred and five degrees; sulphate of zinc at a strength of one-eighth; and carbolic acid is used at a strength of one to forty, and down to one per cent and even less. For watering streets and gutters, it is used as weak as one of acid to one thousand of water. Hydrochloric acid is applied to urinals and slaughter-houses at a strength of one-sixth to one-tenth. Nitro-benzole is also employed of the same strength.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

WATER-WORKS FOR EASTHAMPTON, MASS.—Engineer Davis has been instructed by the water committee to go on and make estimates for getting water into the village from the Turkey hill brook, so that a special meeting will be called during the summer to act on the matter. It is estimated that the whole cost of the works will be over $150,000.

BIDS FOR WATER-WORKS.—A dispatch from Tyler, Tex., says: "At a meeting of our citizens last night it was decided to leave it open to bids from different companies represented here on the subject of water-works for our city, and it is a decided fact that we will have the benefit of this addition to our now growing city."

THE CURTIS REGULATOR COMPANY of Boston has recently received an order from the Lockwood Company for three sets of their pressure regulators and steam traps for their new mill at Waterville, Maine.

MINNEAPOLIS, MINN., will extend a 16-in. main from the water-works up Third street to tap the Hennepin avenue main, to give that and its connecting mains a better supply of water.

WASTE OF WATER FROM CLOSETS.—A Cincinnati dispatch says: At yesterday's session of the Board of Public Works the Superintendent of Water-works reported that the recent inspections of waste of water have resulted in the discovery of an alarming abuse of water privileges, designedly and carelessly done. They consist mainly of the propping up of water closet handles. A long list is given of parties detected. The flow of water, if constant under average pressure, will be not less than 20,000 gallons per day from a water closet, or equivalent in money to $2.40 per day. The Superintendent recommends that a fine of $5 be imposed upon each person detected in a willful waste of water. The report was adopted.

WATER PRESSURE AND TEMPERATURE OF ARTESIAN WELLS.—At a recent meeting in Chicago of the Academy of Sciences Dr. Andrews gave a description of the academy's examination of the water pressure, temperature, etc., of Judge Caton's artesian well. The temperature at the bottom, 2,000 ft. down, was about the same as at the top, or about 78 degrees. The bottom, in temperature, is only about 23 degrees higher than the air at the surface of the earth. The increase in temperature was only one degree in 98 ft. in depth, while in Europe 20 ft. made the same increase. The water contains 64 grains of salt to the imperial gallon. An adjacent well contained 48 grains of salt to the gallon.

THE Municipal Gas Company, of Brooklyn, N. Y., has increased its capital to $3,000,000.

METERS.—During the month of May the National Meter Company, of this city, sent away seven 10-inch "Gem" meters; three for the city of Buffalo and four for the city of Bayonne, N. J. They also sent fourteen 3-inch "Crown" meters to Boston. A fast accumulation of orders and the bright prospects of the future compelled the company, during the past month, to increase the capacity of the works in all the departments. The foundry has been extended and new furnaces and ovens placed beside those already in position; the floor space of the machine shop has been increased to permit of the addition of new machinery specially designed for the work.

THE HUACHUCA WATER COMPANY have pipes laid to Tombstone, Arizona Territory, and will deliver water in a few days. The source of supply is at the Huachuca Mountains, being the concentration of several streams from the different cañons of the mountains. The cost of the works exceeds $500,000.

ELECTRICITY.

BLASTING BY ELECTRICITY.—Electricity is now employed in firing the charges in blasting stone in the quarries at Huntington, Ind., and it is estimated that a saving of 50 per cent. is effected over the old plan.

A NEW USE FOR ELECTRIC LIGHTS.—Thursday evening, at 10 o'clock, a flock of wild ducks in their flight over this city, were attracted by the brilliant glare of the electric light on the Bank street mast, and several of the birds flew directly against the lamps, shattering three of the glass globes and bringing down three good fat ducks, which were triumphantly carried away by passers by. The lights that were interfered with went out, but the others burned more brilliantly than before.—*Cleveland Plaindealer.*

DALLAS, Texas, will be lighted with electricity.

TELEPHONE LINE.—The work of constructing the telephone line between Saratoga Springs and Albany will be commenced next Monday. The new line will include Schuylerville in its circuit, and Manager Sturges expects to have it operating to that village inside of a week and to Albany about the middle of June.—*Saratogian.*

STREETS, DRAINAGE, ETC.

THE City Engineer of Minneapolis, Minn., has been authorized to advertise for proposals for the constructing of several culverts.

RAILROADS.

NORFOLK & WESTERN RAILROAD COMPANY.—Monthly statement of earnings and expenses for April, 1882:

Gross earnings	$171,793.32
Expenses	104,980.61
Net earnings	$66,812.17

For four month, January 1st to April 30th:

	1882.	1881.	Inc. or Dec. in 1882.
Gross earnings	$664,793.06	$688,637.87	D. $23,844.21
*Expenses	410,744.39	374,969.15	I. 35,775.24
Net earnings	$254,048.27	$313,668.72	D. $59,619.45

*Expenses include estimated proportion of yearly taxes.

THE COLUMBUS & NORTHWESTERN.—It seems to be a settled fact that the Columbus & Northwestern Railway Company intend to build a branch from Columbus to the coal-fields. The road is intended to make a through coal road to Chicago from the extensive fields below here.

RAILROAD PROGRESS IN TEXAS.—The work of pushing the construction of the Sabine Pass & Texas Northern Railway is progressing.

NORTHERN PACIFIC PLANS.—Henry Villard, President of the Northern Pacific, stated, at a reception tendered him in Philadelphia recently, that the Oregon Transcontinental Company intends to build tributary lines through the territory traversed by the Northern Pacific.

THE SAUK CENTER NORTHERN.—SAUK CENTER, Minn., May 26.—Ground was broken yesterday on the Sauk Center Northern at this point. The contract is let for some distance beyond Long Prairie, and the work will be pushed with all possible speed.

THE D. M. & ST. L.—Orders have been issued to commence track laying on the Des Moines & St. Louis, Wabash road, between Des Moines, Ia., and Albia. There are yet 25 miles of track to lay, and it is expected to complete it and bring trains into Des Moines by July 1.

THE GRAND FORKS & MISSOURI.—Mr. Johnson, the engineer in charge of surveys for the Grand Forks & Missouri Valley Railroad, announces that the necessary help has been secured and the party organized. They expect to start out the first of next week, and will run the first line without taking any levels, their purpose being simply to get an idea of the topography of the country with reference to the engineering difficulties and also the final success of the road after it is built. The objective point for which the party will start is Oriska, 85 miles distant, which will probably be reached within three weeks. The return trip will then be made, and as the final route will by that time have been decided upon, the levels will then be taken.—*Grand Forks Plaindealer.*

NEW RAILWAYS TO BISMARCK.—A dispatch from Bismarck, Dakota, says: "A letter was received to-night by a Bismarck merchant from a prominent railroad official, stating that the Northern road would finish a survey to this point immediately, and it was not improbable that the road would be built this year. The Chicago, Milwaukee & St. Paul was surveyed to within twenty-five miles of Bismarck last fall. The bulk of immigration now being to points west of the Red River Valley to the Missouri slope, coupled with the fact that the enormous quantity of government supplies are annually shipped from here to various northwestern military posts via the river, it would seem that the roads want a slice of the business; besides, both Chicago and Milwaukee are anxious to get some of the Dakota wheat now shipped almost entirely via the Northern Pacific to Duluth and Minneapolis."

VICKSBURG, SHREVEPORT & PACIFIC.—SHREVEPORT, La., May 25.—Dispatches received here state that Major R. H. Greene, Chief Engineer of Rio Grande & Mississippi Railway, now being surveyed, will establish headquarters here instead of at Houston, Tex. This is said to be a continuation of the Vicksburg, Shreveport & Pacific Railway, of the Erlanger combination from here to the Rio Grande River, crossing near Eagle Pass, thence to the Gulf of California. Surveying parties have been out for the past two months, and it is thought establishing headquarters here means the construction will be commenced at this point and pushed through as rapidly as possible. The work on the gap between here and the Mississippi River is progressing rapidly.

RAILWAYS IN MEXICO.—LAREDO, Tex., May 21.—The Mexican National Railway passed Bustamente, Mexico, which has a population of 4,030, on the 29th inst., and reached Villa Aldama, which has also a population of 4,000, last night, and is now 110 miles west of the Rio Grande River. The work has been accepted by the Mexican government. A celebration by citizens of both sides of the river will take place this week, which promises to be on a grand scale. Application has been made to open this section of the road for traffic to Villa Aldama, which will entitle the company to a subsidy of nearly $2,000,000. The Mexicans are enthusiastic over the project. It is expected that the road will reach Monterey in September. The first mile of the Rio Grande & Pecos National line was laid on the 29th inst., and operations on the International extension will begin shortly. This section of the Rio Grande border is unusually peaceable at present.

THE ST. LOUIS & SAN FRANCISCO.—Messrs. Fruin & Swift, contractors for the grading of the St. Louis & San Francisco Railroad track between St. Louis and Kirkwood, have received orders to suspend further operations. By this order 500 men and 150 teams are thrown out of employment. Work has already been done to the amount of $150,000, in addition to the heavy expense of purchasing property for the right of way.

TALKED-OF EXTENSION.—It is given out in railroad circles that the Missouri Pacific Railroad intends extending its double track from Laclede to Kirkwood. Work will continue on the St. Louis & San Francisco track from Kirkwood to Franklin, or Pacific, as it is indifferently called. This arrangement will give the Missouri Pacific a double track from St. Louis to Pacific, and will probably set at rest the negotiations for the purchase of a right of way to Pacific via Crève Cœur Lake, or which is known as the Labadie cut-off.

CHICAGO & ALTON EXTENSION.—CHICAGO, May 24.—Officers of the Gulf, Colorado & Santa Fe Railway Company, operating 500 miles in Texas, are here conferring with the Chicago & Alton Railroad officials, and have submitted a proposal that the latter extend their lines from Kansas City to the northern boundary of the Indian Territory; that the Gulf, Colorado & Santa Fe extend its line from Fort Worth to the Southern boundary of the Territory, and the two interests unite in a third company to build a line across the boundary 100 miles west of the Missouri, Kansas & Texas, each road to bear one-half of the expense and the Gulf Road to send 400,000 bales of cotton yearly over the Alton. The latter gave very little encouragement to the plan.

COMPLETION OF A SOUTHERN AIR-LINE.—The last spike was driven on Saturday evening last on the extension of the Shenandoah Valley Railroad, thus completing the line between Hagerstown, Md., and Roanoke, Va., where connection is made with the Norfolk & Western Railroad. Direct communication is now made between New York and New Orleans over this road. The line and its connections will be known as the Virginia, Georgia & Tennessee Air-Line. Movements of freight by this route will commence at once and the passenger schedule will go into effect on June 19.

KANSAS RAILROADS.—The State Auditor has completed the computation and distribution of the railroad property assessments for 1882. The assessment of all railroad property reaches the sum of $250,881,646, an increase of $21,416,156 over last year, or nearly 11 per cent. The total mileage of last year was 3,478; this year it is 3,698, an increase of 220 miles. The average assessment per mile of all property last year was $6,518; this year it is $6,515. The increase in mileage from March, 1880, to March, 1881, was 874 miles; from March, 1881, to March, 1882, 220 miles. Kansas has now 81 organized counties, 67 of which have railroads. Seven of the unorganized counties have railroads.

ENGINEERS are locating a railway from Seneca to Mendota, Ill., which is believed to be for the use of the Cincinnati, Indianapolis & Chicago road.

COST OF A ROAD.—The cost to the Chicago, Burlington & Quincy of building and equipping its Denver line will probably exceed $4,000,000. The roadbed, which is pronounced of superior construction, has cost at the rate of $17,000 per mile.

A NEW ROAD INTO TIOGA COUNTY.—WARSAW, N. Y., May 31.—To-day surveyors commenced running the narrow-gauge line from Addison, Steuben County, N. Y., on the New York, Lake Erie & Western Railway, to Gaines, Tioga County, Penna., a distance of 40 miles. This is to be one of the many feeders the Erie road has in process of construction all along its line in order to hold business up to the present standard when the new trunk lines go into operation. Richard G. Taylor, of Buffalo, will be its President.

RAILROAD BUILDING IN CENTRAL AMERICA.—PANAMA, May 24.—The Republic of Salvador is making its first essay in railroad building, and the line from Acajutla to Sonsonate will be opened this month. Although the capital subscribed is altogether local, the enterprise may be regarded as a regular American affair. American engineers ran the lines originally and superintended the construction. Cross-ties and rails were imported from the United States, and only the other day the rolling stock was landed from California—two locomotives and a number of cars of different descriptions. The new road will be under the superintendence of Mr. Robert Nanne.

Considerable interest is felt in the success of another railroad enterprise, a concession for which was granted to General Butterfield, of New York, some months ago. It is known as the "Central Railroad of Salvador." Starting from the capital it traverses the central valleys of the republic, passing by the celebrated lake of Idopango, the cities of Cojutepeque, San Vincent and San Miguel, and making its terminal point at La Union on the Gulf of Fonseca. The government of Nicaragua is organizing two colleges for young ladies, one in Leon and the other in Granada. Sir George Kellner, Mr. Bush and Mr. Menghens, the commissioners of the English bondholders, have returned and accepted the proposition made by the council of foreign bondholders by General Guardia last year This is to complete the road from Rio Sucio to San Jose, under certain conditions, and to operate the same for a certain fixed period. Coffee continues to arrive at Port Limon from the interior, and several thousand sacks are expected there this month.—*New York World.*

INCORPORATED.—DES MOINES, Iowa, May 30.—The Davenport, Iowa and Dakota Railroad, capital 8,000,000, has obtained a legal existence by the filing of articles of incorporation with the Secretary of State.

RAILROAD INCORPORATED.—Articles of incorporation of the St. Croix & Chippewa River Railroad Company were filed with the Secretary of State of Wisconsin. The railroad is to be constructed between a point on the Chippewa River at or near Durand. The length will be about fifty miles. The amount of capital stock will be $500,000.

NEW YORK & BOSTON INLAND.—The Boston *Advertiser* says: "The route now sketched for the projected Boston & New York Inland Railroad to enter this city leaves the line of that originally contemplated at a point where the city of Newton and the towns of Dedham and Needham come together, and thence continues down through West Roxbury and connects with tracks of the West Roxbury branch of the Providence Railroad at a point near what is known as Central Station. In West Roxbury the location, as contemplated, passes directly through the property which was at one time known as the Brook farm. This property is now owned by a German benevolent organization, and is known as the Martin Luther Home. The line enters the West Roxbury District on the estate of George Kempton, near the line separating it from the estate of W. R. Wheeler, and thence continuing, crosses in the order named the following estates and streets: I. D. Richards, Patrick Tracy, Martin Luther Orphan Home, John Cunningham, Baker street, Thomas Cunningham, Lagrange street, A. F. Whittemore (five estates), George H. Burditt, Oak street, James A. Whittemore, Corey street, George H. Gooding, Center street, N. L. Chamberlain, heirs of C. Woodward, Betsey Draper and Richard Dinain, and joins the West Roxbury Branch of the Providence Railroad on the estate of Mary White, near Central station. The new location avoids Brookline and the Back Bay territory entirely. The engineer of the new road estimates the cost of constructing the 60½ miles of road in the state of Massachusetts at $4,775,143."

THE CLEVELAND IRON STRIKE.—A dispatch from Cleveland, O., says: "A new and decided turn has been taken in the labor difficulty at the Cleveland Rolling Mills, and if quite authentic rumors become official it will be bad news for the 5,000 or 6,000 who are out of work because of the strike. The story is that the Cleveland Rolling Mill Company has decided to keep all of its establishment closed until September. Their orders on hand at the time of the strike were comparatively few and unimportant, and a number of them were rescinded on notification. Such contracts as were important are said to have been now transferred to places where there is no trouble, leaving the Cleveland Company unfettered. If the officers of the company have decided on this course, there will be three sore and hard months ahead for the Newburg suburb. In corroboration of the story is the fact that C. F. Emery, who has the contract for all the mill teaming, is now selling off his horses by the score. The leaders among the strikers say that the whole story is a scheme of the Rolling Mill Company to scare them back to work, but that it will not operate. The closing up, however, would be in exact accord with the well known tactics of this company, and would, therefore, cause no surprise It has always managed its own affairs, and would sacrifice no little money before abandoning that management to the amalgamated association. The iron business does not promise great activity this summer, and the closing would be accomplished without much loss."

BRIDGES.

A PONTOON BRIDGE at Dubuque, Iowa, seems to be an assured fact, as the necessary stock, $100,000, has all been subscribed.

BRIDGING THE DES MOINES.—The Chicago, Rock Island & Pacific road is preparing to put a new bridge across the Des Moines River below the packing-houses, Des Moines, for the accommodation of the Winterset and Indianola division. This is done to save the cost of maintaining the expensive track through South Des Moines and around the coal hill bluffs, where land slides are of frequent occurrence. It also makes a saving of distance and a difference of fifteen minutes in time.

NEW BRIDGE.—RICHMOND, Va., May 26.—The temporary bridge of the Richmond & Petersburg Railroad over the James River, to take the place of the burned one, was safely used to-day. Through trains between the north and south over the bridge will be running in a day or two. An iron bridge is being built.

BRIDGE BONDS.—Milwaukee, Wis., will issue $100,000 bridge bonds.

NEW BRIDGE.—One of the many improvements being made at Long Branch this season is the building of Ocean Avenue Bridge, between West End and Elberon. The foundation consists of 28 screw piles, the superstructure of thirty-two Whipple truss girders. The bridge is 250 ft. long and 60 ft. wide, has two sidewalks 6 ft. each, with handsome railing. The bridge is being built by the Cleveland Bridge and Iron Co., of Cleveland, Ohio, superintended by Engineer H. G. Welty.

LARGE VIRGINIA BRIDGE.—The Richmond & Petersburg Railroad bridge over the James is one of the great bridges of the country. It is 2,890 ft. long and from 60 to 75 ft. in height. The material in the bridge will give some idea of its size. There are 1,590 pine poles, 10 in. minimum diameter; over 800,000 ft. sawed timber, not counting cross-ties; over 10,000 iron bolts, besides 16-in. iron spikes.

BRIDGE PIERS COMPLETED.—A note from Laredo, Texas, dated May 25, says: "The last section of the iron piers to the iron bridge of this road across the Rio Grande was completed to-day, and the work of filling the iron casing with cement and broken stone is well advanced, and the permanent bridge will be completed in a few weeks more, which will relieve the road from the embarrassments which have been created by the refusal of the Mexican engineer to report favorably upon the temporary bridge now in use, and the order by by which the Mexican government which will not allow freight of any description to pass over, notwithstanding it is one of the safest railroad bridges on the river."

A PHILADELPHIA BRIDGE.—At a meeting of Council's Committee on Surveys yesterday Chief Engineer Smedley stated that he would be obliged to consult two or three engineers on the matter of repairing Chestnut street bridge, and desired to know how they are to be paid. He said that a careful comparison of measures taken during several years shows that the movement is not limited to the settlement of the retaining walls and earth filling in the lowest approach, but that the longitudinal pressure of the iron arches has an effect on the main abutment, to counteract which provision should be made as soon as possible. The committee agreed to ask Councils to set aside money to pay the engineers out of the appropriation of $50,000 for repairing Chestnut street bridge. The sub-committee havi g under consideration the construction of a new bridge at Market street also met. Plans for a stone and iron bridge were discussed. The stone structure, Chief Smedley said, would cost $1,200,000 and the iron $810,000. The committee decided to recommend the erection of a stone bridge with a width of 100 ft. It will take four years to finish the work.—*Philadelphia Times.*

BUILDINGS.

OPERA-HOUSE.—Council Bluffs, Ia., is talking of an opera-house, to cost between $40,000 and $50,000.

A GRAIN ELEVATOR is to be built at Whitehall, Wis.

CITY HALL.—Richmond, Va., has voted $300,000 for a new city hall.

NEW YORK CITY CONTRACTS.—Bids were opened on May 1 by the Fire Commissioners for the building of new houses for engine companies Nos. 6, 10 and 33. The lowest bids for the three houses, which were referred to the Controller before making awards, were as follows: Engine Company No. 6, at No. 100 Cedar street, $12,255; No. 10, at No. 8 Stone street, $14,500, and No. 33, at No. 15 Great Jones street, $18,000.

STRUCK BY LIGHTNING.—The Rochdale woolen mill, at Poughkeepsie, N. Y., owned by the estate of Elias Titus, was struck by lightning and totally destroyed Sunday afternoon. Loss, $40,000 or $50,000.

LIGHT-HOUSE.—The Senate bill, appropriating $15,000 for a light-house at Little Traverse harbor, Lake Michigan, has been passed.

WORK-HOUSE.—The Common Council of Minneapolis has appropriated $30,000 for procuring a site and building a work-house.

BIDS OPENED.—Bids were opened in the office of Supervising Architect Hill (Washington) for the court-yard, roof and ceiling of the custom-house at Cincinnati, as following: Snead & Co., iron works, $51,886; Haught, Peckham & Co., $57,808; Henvel, Man & Co., $82,538; and Mr. Clements, three bids, the lowest, $84,565.

WILL BUILD A DEPOT.—The Northern Pacific is going to build at Portland, Oregon, one of the largest and finest depots in the world. It is to be built of stone, granite and iron, and will cover twelve full blocks of ground. It will cost $1,500,000.

NEW YORK STATE CAPITOL.—Charles H. Haswell, Consulting and Superintending Engineer and City Surveyor of New York, writes to Assemblyman Benedict in relation to the Assembly ceiling: "Having examined the ceiling of the Assembly chamber in its construction and condition, together with the piers sustaining the columns supporting it, I submit: The piers have settled and the integrity of the ceiling is disturbed. The circumstance that it has been deemed necessary by those fully acquainted with all the elements of the design, support and structure of the ceiling to supplement it with a counterpoise and counterpart, would seem to be conclusive that it is admitted to be defective, either in design or construction, or both."—*Albany Evening Journal.*

LABOR.

NINETY THOUSAND IMMIGRANTS DURING MAY.—On May 31 eight steamers landed nearly 6,000 immigrants from all portions of the Old World. Over 4,000 of the arrivals were males. About 60 silk weavers arrived on the St. Laurent from Marseilles and over 100 millers from Hamburg were on the Ohio. The Ohio, from Bremen, landed 1,282 immigrants; the Hapsburg, from the same port, 1,252; the Anchoria, from Glasgow, 841; the Batavia, from Liverpool, 654; the State of Nevada, from Glasgow, 656; the India, from Hamburg, 492; the Denmark, from London, 456, and the St. Laurent, from Havre, 364, making a total of 5,995. The total arrivals for May were 90,019, against 76,791 for the same month last year, showing an increase of 13,228. This total is the largest ever known in one month in the history of the Garden, and is larger than the arrivals for the whole year of 1876 or of 1878.

STRIKES OF WORKINGMEN.—CHICAGO, May 26.—Dispatches from Muskegon, Mich., this afternoon, announce that the strike at that place has ended. At a meeting of the strikers this morning it was voted by a majority of forty-five to declare the strike ended, and that all who wished might resume work. The strikers return at $2 per day of eleven hours' work, a less price than was offered them by the Boom Company a month ago. There will be a full force at work to-morrow, and all the mills will start next week, as soon as enough logs are rafted to insure steady work.

THE Muskegon strike has cost about $750,000, it is understood, and the loss falls like the rains of Heaven—alike upon the just and the unjust.

EXTENSIVE STRIKES IN THE IRON TRADE.—All the mills in Mahoning valley, in Ohio, refused to sign the wages schedule and no work will be done at any of them. The strike will throw ten thousand men out.

Seven rolling mills in the neighborhood of Cincinnati shut down, and 5,000 men are out of employment. The boilermen demand that the mill-owners sign a new contract. The latter refused. The shut-down extends to Cleveland.

At Pittsburgh thirty-six iron mills shut down June 1, and 18,000 men are out of employment. Five mills signed the scale May 31, but it is not thought this will effect the general situation.

The Laclede Rolling Mills, Hellbacker Forge and Harrison Wire Works, at St. Louis, shut down June 1 in consequence of the difficulty with the workmen.

The iron and nail mills at Wheeling shut down May 31, the proprietors refusing to sign the new schedule. Five thousand men are thrown out there.

CONTRACTS LET.

IRON-WORK FOR BUILDINGS.—The Albany (N. Y.) Architectural Iron-Works have received the contract for all of the iron-work to be used in the construction of five large buildings to be erected at St. Johns, N. B.

DITCH CONTRACT LET.—The contract for digging the six-mile ditch recently advertised in this journal was sold at Wapakoneta, O., on the 27th ult., to nine contractors. The aggregate price was $4,241.10.

CHURCH CONTRACT LET.—Contracts were signed at Boston for the construction of the main building of the People's Church, at a cost of $150,000. The building will be the largest church edifice in New England

ELECTRIC LIGHT CONTRACT.—The city of Springfield, Mass., has contracted for 16 electric street lamps, to burn from dark until midnight, for $3,800 a year, payable in monthly installments. The company offers to continue burning the lamps till 3 o'clock a. m. for $609 additional.

THE contract to build the Huntingdon, Pa., Reformatory has been let to Mr. Sheok, of Erie, his bid being $188,790.

HUNTINGTON, Ind., May 30.—Contracts on the Chicago & Atlantic Railroad have been let as follows: Bridging, Cleveland Iron Bridge Company; track-laying, George B. Harris; fencing, Cleveland Barbed Wire Fence Company.

ARTESIAN WELL CONTRACT LET.—The city council of Peoria, Ill., let the contract for putting down a test artesian well to Marrs & Miller, of Chicago, and ordered the work done at the water-works, instead of the old fair grounds, as heretofore contemplated. The contractors agree to furnish everything except boiler and steam. The surface pipe, which is to extend downward to bed rock, is to be of quarter-inch wrought iron, six inches in diameter inside. The size of the bore through rock is to be not less than five inches, so as readily to admit a four-inch galvanized iron pipe with necessary couplings to any depth designated by the committee in charge of the work. The work is to be pushed forward with all possible dispatch, day and night, and the price to be paid depends upon the depth of the well. If it stops at 1,000 feet the price is to be $2.25 per foot. From that depth to 1,250 feet, the price is to be $2.50; from that to 1,500, $3; from the latter to 1,750, $3.50; from that to 2,000, $4; from 2,000 to 2,250, $4.50; from 2,250 to 2,500, $5; from 2,500 to 2,700, $6; and so on up to 4,000 feet, the last 250 of which would cost $12 per foot.

MISCELLANEOUS.

NEW LINE TO BRAZIL.—The United States and Brazil Mail Steamship Line is the name of a new line of steamers to run semi-monthly between the United States and the South American ports of Para, Maranham, Pernambuco, Bahia, Rio de Janeiro, and Santos, stopping at St. Thomas. The company has three iron steamships now building at Roach's yards at Chester, Pa., each vessel having accommodations for 50 cabin passengers and unusually complete freight arrangements. Light freights and express parcels will be taken from South America for Europe, via New York, on through bills of lading, and express parcels will be carried from New York to South American points. The offices of the company are in this city.

THE WASTE OF WATER.[*]

The attention of successive city councils has repeatedly been called to the necessity of adopting measures for preventing waste of water. Notwithstanding what has been written and said upon the subject, no determined and sustained effort has yet been made to check the evil. When threatened with scarcity of water the remedy has been to extend our sources of supply, and appropriations for that purpose have been readily granted. Nevertheless the purpose has not been accomplished; the consumption of water has kept pace with the supply, and this is largely due to wanton waste and not to the use of water for legitimate purposes. The subject, however, assumes a graver aspect when it is understood that, unless some method is adopted for checking waste, the limit of the Sudbury River supply will be reached in the near future, and new sources will have to be developed.

The capacity of the present water supply of Boston from Sudbury River and Cochituate Lake amounts, in a year of least rainfall, to about 29,000,000 gallons per day, equivalent to a supply of 85 gallons for each inhabitant, calling the population of that part of Boston supplied from these works 340,000. The new storage basin, which is now being constructed on a branch of the Sudbury River at Ashland, will increase the supply about 5,000,000 gallons per day; but the basin will not be completed for two years, and in that time the increase of population, if the present rate of consumption is maintained, will exhaust the full capacity of the works, and the construction of another basin will have to be commenced.

The storage facilities of Sudbury River valley can be developed by the construction of additional basins, so that a supply of about 38,000,000 gallons per day can be obtained; and the combined Sudbury River and Cochituate works can be relied upon for a daily supply of about 48,000,000 gallons. Allowing for the increase of population, and a slight increase in the rate of consumption, the capacity of these works will be reached in about twelve years. The cost of thus increasing the capacity of the works will be at least $500,000.

The average daily consumption during 1881 amounted to 31,000,000 gallons, or 95 gallons per head of population. A comparison of these figures with those given as the present capacity of the works in a year of least rainfall will show that, if such a year should occur before the completion of the new basin, the consumption would exceed the supply.

That this enormous consumption is unnecessary, and is due to illegitimate use and wanton waste of water, is shown by the following table giving the consumption per head of other cities, and also by the fact that when, about twenty years ago, the consumption of Boston reached a rate equal to the present one, a vigorous inspection reduced the amount to a reasonable quantity, and saved for many years the large expenditure which had finally to be made for the construction of the Sudbury River Works:

CONSUMPTION OF WATER PER HEAD OF POPULATION.

	Gallons.
Brooklyn	54.2
Cincinnati	75.9
Cleveland	83.6
St. Louis	72.1
Liverpool	27
Glasgow	60
Providence	36.3
London (average of nine companies)	27.5

It must also be remembered that, in addition to the cost of extending the water-works, the expense of pumping at the improved system of sewerage works will be greatly increased by the extra quantity of water that is wasted and flows into the sewers.

If consumption of water could be reduced to 60 gallons per head, a very liberal quantity for all necessary purposes, the limit of capacity of the present works, including the basin now being constructed, will not be reached until 1900. If the consumption continues at its present rate $3,000,000 will have to be expended before that year for new works, and the interest on this, together with the cost of pumping the surplus quantity of water at the improved sewerage works, will amount in the same period to about $1,500,000, a total of $4,500,000.

There is no question but that 50 per cent. of our present water supply is wasted, and, further, the largest portion of this waste can be prevented without limiting the supply for all legitimate purposes, and without extraordinary expense.

The principal sources of waste of water are,—

1. Defective mains and services.
2. Defective fixtures in buildings.
3. Bad plumbing.
4. Wilful waste.

The loss from the first cause is comparatively slight. Street mains and services in this city are constructed of the best materials, and laid by skilled workmen in the most approved manner. Being under constant supervision, leaks of any extent are soon discovered and immediately stopped. A recent examination in the Charlestown District discovered only 24 cases of this kind, about one-quarter of which were small defects in stop-cocks at the curbs; and the whole amount wasted did not exceed 300 gallons per hour.

Under the head of defective fixtures may be included such as are constructed without regard to economy in the use of water, as well as such as are out of repair.

Among the former, water-closets that are supplied directly from the service pipe, and urinals in which the water is kept constantly running, are the greatest sources of waste.

The quantity of water used in the form of closet referred to, even with proper care, is much greater than is needed, but its chief fault is that users are in the habit of fastening the valve open, so as to keep up a continuous flow of water from a mistaken idea that a constant flow of water down a closet promotes cleanliness. An examination of the water fixtures in Charlestown, made during the past year, showed that a large part of the waste was due to this cause.

Another wasteful form of fixture is the self-acting closet, operated by opening a door or by seat pressure, by which a constant flow of water is maintained while the closet is in use.

The ordinary pan-closet, supplied by a tank and ball-cock, is frequently a source of great waste, in consequence of the valve and tap becoming worn. Careful attention would prevent this, but usually the slight dripple from the tank, as it does no harm, is either overlooked or neglected.

The following results of four cases recently examined will serve to illustrate the waste caused by defective water-closets.

Meters were placed upon a block of four houses at the South End, and the quantity of water consumed ascertained. An examination made about the first of May revealed the following defective fixtures:

CASE NO. 1.

Hopper cock to water-closet defective, and could not be depended upon to shut off the water when not in use.

Consumption 445 gallons per head.

CASE NO. 2.

Handle to hopper-cock furnished with the necessary appliance for fastening it, open. The owner was suspected of keeping it open (during cold weather at least), so as to permit a continuous flow of water down the closet.

Consumption 109 gallons per head.

CASE NO. 3.

Hopper-cock out of order and wasting.

Consumption 310 gallons per head.

CASE NO. 4.

Ball-cock in cistern defective, and would not shut off water when not in use.

Consumption 182 gallons per head.

The owners were required to repair the defects, and an examination made on the 24th of May showed the following result:

	Daily consumption per capita, before repairs. Gallons.	Daily consumption per capita, after repairs. Gallons.
Case No. 1.	445	21
Case No. 2.	109	36
Case No. 3.	310	73
Case No. 4.	132	73
Total	996	203

When it is understood that many thousand cases like the foregoing exist in Boston, the great loss from this source of waste will be appreciated.

In places where the subject of prevention of waste has received the attention it deserves, the use of the defective form of closet is either interdicted, or a proscriptive tariff is laid upon it. There are 1,069 urinals in Boston so constructed that a constant flow of water is kept up day and night. It is true that the stream is small, so small in fact as to be, in most cases, ineffectual as far as purification is concerned; but the waste is going on all the time, and the aggregate quantity of water consumed is very large. The waste from water-fixtures, that are out of repair, either from wear and tear or inferior materials and workmanship, cannot be estimated, but is probably much larger than from all other sources combined. A leaky faucet is usually neglected until it becomes a source of annoyance to the householder; for the only inducement to rectify it is his duty to the city—a duty which is liable to be thoughtlessly postponed.

On this point an English writer says:

"A little rill, trickling down a mountain side, looks very insignificant; nevertheless, little rills make big rivers. So with waste; a slight leakage from a tap may seem very unimportant; but slight leakages gradually exhaust huge reservoirs. A mere dribble from a tap, continued for years, represents in money-value the water-rate of an artisan's cottage."

Close competition in the manufacture of plumbing materials has caused great deterioration in quality, and the market is flooded with inferior water-fixtures. There is a close connection between the use of such fixtures, and what we term the third and fourth sources of waste, i. e., bad plumbing and wilful waste; for bad plumbing includes the use of poor material and unskillful workmanship, and both lead to waste.

Unfortunately, the plumber's work is usually concealed, and its defects are not discovered until damage ensues. An imperfect or unsound joint, from which the water oozes and follows down the pipe, may not be noticed until the leak enlarges under pressure and the premises are deluged. It is not until use reveals the defects that cheap fixtures show their unserviceableness, and contribute to the waste of water. Pipes placed where they will freeze unless a current is kept through them, lead to wilful waste; for, after one experience, with bursting pipes, the householder, with the recollection of damaged premises and plumber's bills on his mind, can hardly be expected to resist the temptation to let the water run. It is well known that a fall in temperature and an increase in consumption of water are coincident. In extreme cases the waste from this cause is from thirty-five to fifty per cent. of the amount supplied. Cold-weather waste is, therefore, one of the greatest sources of waste, and is likewise one that is due entirely to bad plumbing. The use of hand-hose for irrigation, although not strictly a waste of water when kept within reasonable limits, is a severe tax upon our water supply.

PREVENTION OF WASTE.

Prevention of waste does not mean stinting the supply; on the contrary, it means that every taker shall have a full and liberal allowance of water, sufficient for all purposes, but that the careless or indifferent shall not, by wanton waste, deplete the sources of supply, and increase the burden of taxation by necessitating their constant extension. Boston can easily afford to furnish an ample supply of water to all, but it cannot afford to have 12,000,000 gallons a day uselessly thrown away.

The principal methods of preventing waste are:

1. The meter system.
2. House-to-house inspection.
3. The waste-water meter system.

The meter system is, of course, the most effectual method of preventing waste. By it every taker pays for the exact quantity of water consumed. Self-interest is, therefore, directly appealed to, and the conservation of all water not actually required for use is effected.

As an illustration of the saving effected by the use of meters, a comparison between the cities of Newark, N. J., and Providence, R. I., may be of interest.

Newark, with 10,000 services and but few meters, has a daily consumption of 10,000,000 gallons and a revenue of $100,000; Providence, with the same number of services and about 5,000 meters in use, has an average daily consumption of 4,000,000 gallons and a revenue of $260,000.

House-to-house inspection answers very well for detecting and preventing waste proceeding from defective fixtures. In Cambridge, where the system is in operation, the consumption has been maintained at about 50 gallons per head. It was adopted in Boston in 1864, and continued for about 18 months. In 1861, the consumption was up to 100 gallons per head, and remained at or near that rate until house-to-house inspection was begun, when it fell to 66 gallons. The inspection was practically discontinued in 1866, but the effect was felt until 1872, when the Sudbury River supply was turned on. From that time it has gradually increased to its present amount.

Practical experience has shown that the most satisfactory, as well as least objectionable, method of preventing waste, is a combination of house-to-house inspection with the meter system, and vigorous inspection of plumbing—in other words, the waste-water meter system.

This system was invented by Mr. George F. Deacon, C. E., Water Engineer to the City of Liverpool, England, and is in successful operation in many European cities.

In Liverpool it effected a reduction of 60 per cent. in the consumption of water from 1873 to 1880, without detriment to the manufacturing or sanitary interests of the city.

The Chairman of the Liverpool Water Committee, in his address in 1879, speaks of the system as follows:

"We have given the city a constant service of water, with a decline in the death-rate, and it now remains for me to show what other effects have arisen from the change of system. In the year 1871 we delivered an average of 122,000,000 gallons weekly. In 1880 our deliveries will be about 115,000,000 gallons, and this, notwithstanding an increased sale for trade purposes of 12,250,000 gallons weekly, and an increased population of 104,000. The saving has been so great as to meet the increasing demands of the city and district for eleven years.

"The change to constant service has already yielded nearly a quarter of a million of money (£250,000,) and the ultimate saving to the ratepayers, when the 7,000,000 gallons per week, yet unsold, are absorbed, will be £50,000 per annum."

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[*] Report of the Joint Standing Committee on Water, city of Boston, instructed to investigate and report upon the best method of restricting the present waste of water.

In the Deacon system the waste-water meter is used to locate sources of waste. This meter does not, like the ordinary meter, record the number of gallons consumed, but it indicates the rate of flow at any given time, and whether the discharge is due to steadily flowing waste, or to intermittent and ordinary use. It, therefore, enables the observer to determine, by observations taken at those hours when no water, or a very small quantity, is used for legitimate purposes, whether waste is going on.

The meter consists of a hollow cone, having its small end upwards, and containing a composition disk, of the same diameter as the small end of the cone. A vertical spindle, attached to the upper surface of this disk, is suspended by a fine German-silver wire, which passes, practically water tight, through a small hole in the top of the chamber, over a pulley, and supports a weight. This weight is so adjusted as to retain the disk at the top of the cone when the water is at rest. When any water is drawn through the meter, the disk is pressed downward toward the bottom of the cone, its position depending upon the amount of water passing through the meter. By means of a pencil attached to the wire the motions of the disk are recorded on a drum, which revolves by clock-work, once in 24 hours.

The meter is placed in a box under the sidewalk or roadway, and so located as to control the flow of water supplied to a certain district, the limits of which have been previously determined. All the water used in this district is drawn through the meter, and the quantity and rate recorded. After a few diagrams have been taken, to show the ordinary rate of consumption, inspection is commenced. Every service-pipe is provided with a stop-cock, which is accessible from the sidewalk by means of an iron wrench about 7 ft. long. When this wrench is applied to the stop-cock the sound caused by water passing through the service-pipe can be easily distinguished. When no noise is heard, with the stop-cock fully open, it is partly closed, and the increased velocity always causes a distinct sound, although the quantity of water passing the stop-cock may be very small. A night inspector begins his work about midnight, and tests, by means of his shutting-off wrench, each service-pipe. If he discovers any flow through the service-pipe, the stop-cock is closed, and a note made of the time and the number of the house. He continues this operation through the district until about 4 a. m., when he retraces his steps, and opens all the stop-cocks he had found wasting. During this time the meter is recording the consumption, and the diagrams show the amount of water wasted by each of the service-pipes that were closed, the time the inspector began and finished his work, and the time each stop-cock was closed. The day inspector receives the night inspector's report, visits the premises where waste was noted, and ascertains the cause. In cases of waste from defective fixtures the owners are notified to repair the same, and the visits are continued until the notices have been complied with.

The economy of this system, as compared with house-to-house inspection, is apparent. The attention of the inspector in at once directed to the place where the waste is going on, and the time lost in indiscriminate inspection is saved.

The system was recently tested in Charlestown, the only section of the city to which it could be easily applied, and resulted in reducing the average daily consumption of 21,760 persons from 58.5 to 37.7 gallons per head, a saving of 20.8 gallons, or 35.6 per cent. per day for each person supplied, while the night rate was reduced from 37.5 to 15.8 gallons per head, a saving of 58 per cent. The total saving in the district amounted to 450,000 gallons per 24 hours, which, at two cents per hundred gallons, the price of water at meter-rates, represents an annual saving of $32,850.

There are, however, objections to adopting, in its entirety, either of the foregoing systems in Boston.

With the meter system there would be danger of reducing the consumption to a point below what is considered desirable for sanitary purposes. Again, it would cost more than a million and a half dollars to introduce the system, and a very large outlay would have to be made annually for repairs. Lastly, it is feared that, if the water was charged for at present meter-rates, the revenue would be reduced to an extent that would compel an increase in the price, and thereby injuriously affect manufacturing interests.

The system of indiscriminate house-to-house inspection fails to prevent waste from unsuitable fixtures, or from running water at night to prevent freezing. Besides it is objectionable to the careful person, whose fixtures are kept in repairs, and who naturally regards the constant visits of the inspector as an invasion of his domiciliary rights.

The objection to the immediate application of the waste-water meter system is its cost. Nearly all the stop-cocks in the service-pipes are located in the roadways, and are inaccessible except by removing the surface to the depth of a foot or more. The expense of changing the positions of the stop-cocks to the sidewalks would aggregate about $350,000. The saving that would be effected in the use of water in a series of years would, however, render even this large expenditure an economical measure, if there were no other methods by which the object could be accomplished.

It is believed, however, that a combination of the recording-meter system and the Deacon system, with house-to-house inspection, would work successfully in this city, and a plan has been considered, of which the following is a brief outline:

It is proposed to extend the use of the recording-meter gradually, as the Water Registrar may consider expedient, applying it only to manufacturing establishments and other places where large quantities of water are used and waste is suspected. These meters will be put on to determine and check waste, and will not be retained in use unless found to be necessary. The usual water-rates must be retained in order to raise the revenue required by law, except in cases where it may be found desirable to charge for the quantity of water consumed at meter-rates.

It is further proposed to divide the city into districts, as in the Deacon system. A waste-water meter will be placed on each district; and the consumption of water ascertained as a preliminary to beginning house-to-house inspection. A thorough inspection will then be instituted; all sources of waste will, of course, be discovered and remedied. At the same time the meter will be registering the consumption and will show the saving that is effected. Inspection being finished, and consumption reduced to what is considered a reasonable quantity, the meter will be left on the district for a time in order to detect any increase. If, after a few weeks, it is found that consumption does not increase, the meter will be removed to another district and the same process gone through with. In this way it will be possible to cover the whole city with a few meters, and without immediately expending a large sum of money for changing stop-cocks, etc. The result of each day's work can also be better ascertained, and the inspectors can be sure that their work has been thoroughly done in each district before passing to the next.

While this plan does not do away entirely with domiciliary visitation, the visits are made less frequent than would be the case if meters were not used; for, if after one inspection of a district, it is found that the consumption of water has been reduced to a proper point, inspection is discontinued and not renewed as long as it is kept at that point.

Twenty waste-water meters will be required to commence with. This will, of course, be only a beginning; but the work will proceed gradually, as the income will warrant, until the locations of all stop-cocks in the city are changed from the roadway to the sidewalks, and the Deacon system is adopted in its entirety.

The management of this part of the plan should be given to the City Engineer, in whose hands the experiment with the Deacon meter has already been so successful.

The expense of adopting the foregoing system is estimated as follows:

4,000 recording meters	$100,000
20 waste-water meters, and expense of connections	25,000
	$125,000

No system of preventing waste will yield entirely satisfactory results unless it includes a rigorous inspection of plumbing.

It is not sufficient that this inspection should be confined to an examination of fixtures that are out of repair; it must comprise the licensing of plumbers, an inspection of material, and a supervision of the work.

This necessity has been recognized in other cities, and stringent regulations have been adopted with most satisfactory results. Such regulations, properly enforced, not only prevent waste of water, but also protect the public from loss occasioned by bad plumbing, and, in the end, are an advantage to plumbers; for, if all are required to use the same quality materials, no one can have any advantage over another, and, if only first-class mechanics are licensed, sham workmen will be driven from the field. Another and more important aspect of the case is the relation which good and bad plumbing respectively bear to the public health. It is unnecessary to discuss the value of house sanitation, or the danger arising from badly constructed and improperly ventilated soil-pipes and water-closets. It is a matter of common knowledge that many of the zymotic diseases are traceable to these causes. An unskillful or incompetent person should not, therefore, be allowed to trifle with the health and lives of our citizens.

In Liverpool and other English cities the plumbing regulations are very stringent, comprising the inspection and approval of all fittings before use, and extending to the condemning and removal of all improper fixtures. In Lawrence, Mass., plumbing regulations were adopted last year. Builders are forbidden to cover in, or in any manner hide from view, any part of the plumbing-work of a house, until the same has been inspected and approved by the agent of the Board of Health. The agent is required to condemn and order the removal of any work that does not conform to the regulations. Washington, New York, Brooklyn and Providence enforce plumbing regulations, and all plumbers are required to be registered and licensed. In the three cities first named it is unlawful for an unregistered person to carry on the plumbing business. In all these cities the use of wasteful fixtures is discouraged by placing a high water-rate upon them. In New York, particularly, the rate is very high on the wasteful forms of water-closets, while the tax upon the double-valve cistern closet is only two dollars a year, as an inducement to substituting that fixture, which is in every way superior, on economic and sanitary grounds, to the old styles.

Several unsuccessful attempts have been made to enact regulations in this city.

The City Council was authorized, by chapter 105, acts of 1880, to prescribe rules and regulations for the inspection, materials, construction, alteration or use of all water-pipes and water-fixtures of every kind, but no regulations have been adopted. An act has been passed this year (chapter acts of 1882) giving the City Council authority to require the registration of plumbers, and to provide for the inspection of plumbing by the inspectors of buildings.

All the evils arising from bad plumbing could not be remedied in buildings already constructed without a more thorough overhauling of the work than would be practicable, but regulations can be made now that will be efficient in the future.

In conclusion, the committee submit the following recommendations:

First.—That a loan of $125,000 be authorized for the purchase of meters.

Second.—That the Water Board be authorized to expend $100,000 of that loan in purchasing recording-meters, to be applied to such places as may be recommended by the Water Registrar.

Third.—That the City Engineer be authorized to expend, under the direction of the Water Board, the remaining $25,000 in purchasing and attaching waste-water meters.

Fourth.—That the City Engineer, under the direction of the Water Board, be authorized to appoint, from time to time, such number of inspectors (not exceeding twenty) as may be required, and to carry on the proper inspection in connection with the waste-water meter, the expense to be charged to the revenue from Cochituate water.

Fifth.—That an ordinance, providing for the registration of plumbers and inspection of plumbing, be passed immediately.

The committee respectfully submit the following orders embodying their recommendations:

Ordered, That the City Treasurer be authorized to borrow, under the direction of the Committee on Finance, the sum of $125,000, the same to constitute a special appropriation for the purchase and attachment of water meters; $100,000, to be expended by the Water Board, in purchasing recording-meters, and $25,000, to be expended by the City Engineer, under the direction of the Water Board, in purchasing and attaching waste-water meters.

Ordered, That the City Engineer, under the direction of the Water Board, be authorized to appoint, from time to time, such number of inspectors as may be required, provided that the whole number appointed shall not exceed twenty; and to carry on the necessary inspection in connection with the waste-water meter, the expense to be charged to the revenue from Cochituate Water-works.

Ordered, That the Committee on Ordinances be requested to report an ordinance providing for the registration of plumbers and inspection of plumbing.

THE TAMARACK SWAMPS.—The "Tamarack swamps," near Sharpsville, Pa., were supposed to be an innocent sort of bog until the New York, Pennsylvania & Ohio Railroad Company undertook to lay a solid roadbed across them. At first a few thousand cubic yards of earth were dumped upon the surface by the contractor with careless curiosity, as much as if to say, "That will satisfy your appetite, my soft friend." But when the earth immediately disappeared and left no trace behind, a coarser diet was substituted. The company purchased from a furnace the accumulated cinders of 10 years, and since January about 5,000 car loads of this substantial provender have been dropped into the swamp's voracious maw without visibly decreasing its capacity. Occasionally at night there are evidences of repletion, but in the morning the murky water presents an unruffled face and asks for more. A solid roadbed could be laid close by, entirely avoiding the swamp, but the company has elevated its corporate back, and does not intend to be beaten by a miserable tamarack swamp as long as there is a dollar in the treasury.—*Exchange.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 179.

CCCXX.—FAIR HAVEN, VT.

Fair Haven, Vermont, in lat. 43° 37′ N., lon. 73° 16′ W., is on Castleton River, a small stream. Settled in 1779, it was incorporated in 1820 as a village.

Water-works were built in 1880 by the village, taking the supply from a lake of 80 acres' area, fed by springs and having a very small water-shed. It is 3.4 miles from the village and 200 ft. above it. The water is drawn from the lake through a tunnel in rock, 150 ft. long and 35 ft. below the summit of the high ground adjoining the lake. The water is conducted to the village by cast-iron pipes. The first 500 ft. is of 10-in. diameter, and then there are 3½ miles of 8-in. pipe. Distribution is by 5½ miles of 6, 4, 2 and 1-in. pipe, with 27 fire hydrants, 15 gates and 170 taps.

The population in 1880 was 2,211. The consumption is not given.

The works have cost $36,500, and the receipts have been $2,508. The bonded debt is $35,000, at 5 per cent. interest.

The expenses in 1881 were $594.53 and the receipts $1,558.88.

The works are managed by three commissioners, one being elected each year.

James Pottie is Chairman of the Board.

CCCXXI.—HANOVER, N. H.

Hanover, New Hampshire, in lat 43° 42′ 15.3″ N., long. 72° 16′ 55.8″ W., is on a plain half a mile from and 125 to 175 ft. above the Connecticut River, and divided into two parts by a rocky ridge which rises at Observatory Hill to about 100 ft. above the plain. It is the site of Dartmouth College, and was settled under a charter granted July 4, 1761.

Water-works were built by a private company in 1821, taking the supply from springs near the foot of a steep wooded hillside, the soil of which is saturated with water. The company now controls 85 acres of this slope. The water is collected in five wells, 4 to 6 ft. diameter, and 8 to 12 ft. deep, lined with dry stone walls. From the lowest of these wells, 60 ft. above the village, it is conveyed to the village in a pipe 2 miles long. From 1821 to 1828, the pipe was bored pine logs. In 1829 this was replaced by a 1½-in. lead pipe, and in 1880 this was replaced by a 2-in. lead pipe. From the well the pipe descends 60 ft. in the first 1,000 ft. to a brook, across which it is carried in a wooden box laid on the granite bed of the stream, and held down by boulders. Although seldom entirely submerged, the pipe has never frozen, even with the temperature of the air at 35° below zero F. The original pipe was badly aligned vertically, being laid following a very broken and undulating surface. The new pipe was laid on more regular grades.

Near the village it passes a hollow under a head of 110 ft. The pipe used is of the following weights: Under 60 ft. head or less, 7 lbs. per foot; under 60 to 80 ft. head, 8 lbs.; and under 80 to 110 ft., 9 lbs. per foot. Distribution and service pipes are all of lead. There are no fire hydrants or gates. There are about 160 taps. The water is delivered to consumers through gauge butts of copper, perforated with a hole "of the size of a medium-sized sewing needle," which was intended to supply 40 gallons per day, but, with the new pipe, delivers so much more that it has been necessary to throttle the delivery at the well by closing the stop gate eight-tenths of its diameter.

The population in 1880 was 800. The consumption is about 6,500 gallons per day. The works have cost about $12,000. The capital stock of the company is $10.000. The cost of maintenance is very small. The receipts are about $950 per year, being six dollars for each "share" or quota of 40 gallons per day delivered.

The works are managed by the president, who receives a nominal compensation, and three directors, who serve without pay.

CCCXXII.—HANOVER, PA.

Hanover, Pennsylvania, in lat. 39° 47′ N., long. 77° W, is in an elevated valley on no water course.

Water-works were built in 1874 by a private company, after the plans of Robert K. Martin, C.E., taking the supply from mountain springs, the water of which is impounded by dams across ravines, in two reservoirs of 2,500,000 and 1,500,000 gallons capacity, 175 ft. above the town.

Distribution is by 6 miles of 8, 6 and 4-in. cast-iron pipe, with 26 fire hydrants, 9 gates and 253 taps. One meter is in use. The town pays $5 per year for each fire hydrant. Service pipes are reported to be of 1½-in. cast-iron pipe.

The population in 1880 was 2,317. The daily consumption is 80,000 gallons.

The capital stock of the company is $30,000. There is no debt. The works have cost $38,000.

The expenses in 1881 were $1,835.45, and the receipts $963.85.

S. Keefer is the President and General Manager, and R. M. Wirt, Secretary and Treasurer.

CCCXXIII.—SOMERVILLE, MASS.

Somerville, Massachusetts, in lat. 42° 23′ N., long. 71° 7′ W., is a suburb of Boston, on the Mystic River. The surface is undulating, rising from 10 ft. above low-water level to 120 ft. Originally a part of Charlestown, it was set off from that town in 1842, and was incorporated as a city in 1872.

In 1868 water was introduced from the Mystic Lake water-works of Charlestown, described in the account of the Boston works on p 142 of ENGINEERING NEWS, April 9, 1881. The Somerville works were constructed by the city after the plans of Roberdeau Buchanan. The Mystic works are owned by the city of Boston, the pumping station being, however, in Somerville, and the supply mains of 24-in. and 30-in. diameter passing through the city; the distribution pipes for Somerville are connected with them at fifteen different points. Distribution is by wrought-iron and cement pipes, of which 45½ miles were in use on May 1, 1881, with 283 fire hydrants, 392 gates and 1,227 taps. There are 31 meters in use. Service pipes of lead, of rubber-coated and of enameled iron are used.

The pipes are maintained by Somerville, but the water rates are collected by Boston, and out of them there is returned to Somerville a certain percentage, which in 1881 amounted to $14,687.37. The cost of maintenance in 1881 was $14,000. The city pays annually $20 for each 350 inhabitants.

The population in 1880 was 24,985. The consumption is not known.

The works have cost $342,608.76. There is a bonded debt of $335,000, at 5 and 6 per cent. interest. The works are managed by a Board elected annually by the City Council. The Board elects a superintendent annually. Nathaniel Dennett has been Superintendent since 1877. Work of construction is in charge of the City Engineer. This position has been held by George A. Kimball since 1876.

CCCXXIV.—PASSAIC.

Passaic, New Jersey, in lat. 40° 52′ N., lon. 74° 15 W., is on the Passaic River, which is there dammed, affording a valuable water-power. The city is on ground, level near the river, but rising steeply from the plain to more than 100 ft. elevation.

It was settled in 1680. The Dundee Water-Power & Land Company, incorporated in 1872, caused a rapid increase of population. Water-works were built by the Acquanonck Water Company in 1872, after plans of Gen. Thomas D. Hoxsey, taking the supply from Vreeland Lake, a reservoir formed by impounding Weasel brook by a dam 40 ft. long and 12 ft. high, a mile from the village. To this supply, which is very limited, is added water from the river, which is lifted 125 ft. into a reservoir of one million gallons' capacity, by a pump driven by a turbine wheel and a supplementary steam engine.

Distribution is by 9½ miles of wrought-iron and cement pipe of from 12 to 4-in. diameter, with 68 fire hydrants, 18 gates and 250 taps.

The city pays $40 per year for each hydrant. Lead service pipes are used.

The population in 1880 was 7,000 and the daily consumption 500,000 gallons.

The capital stock of the company is $100,000. The works have cost $110,000. The amount of the bonded debt, which carries 6 per cent. interest, is not stated. No further financial statements are given. Washington Paulison is the Secretary, and T. D. Hoxsey the Superintendent and Engineer.

CCCXXV.—NEWCASTLE, PA.

Newcastle, Pennsylvania, in lat. 41° 2′ N., long. 80° 14′ W., at the junction of Shenango and Neshannock creeks, is on flat ground, surrounded by high hills.

Settled about 1800, it was incorporated as a borough in 1825 and as a city in 1869.

Water-works were built by a private company in 1881 after plans of James H. Harlow, C. E., taking the supply from Shenango Creek and pumping it by a Blake duplex pump into a reservoir built in excavation and embankment on a hill 2 miles north of the city. The reservoir contains 6,500,000 gallons at 266 ft. above the city. It is 150 by 188 ft. at the bottom, and 24 ft. deep. There is a berm 8 ft. wide at 14 ft. above the bottom. The bottom and slopes are covered with 2 ft. of puddle and above the berm the slopes are paved with dry stone on edge, 15 in. deep, on 9 in. of broken stone.

Distribution is by cast-iron pipe. The force and supply mains are of 12-in. diameter, and there are 12 miles of mains of from 10 to 4 in. diameter, with 95 fire hydrants, 60 gates and 88 taps. Two meters are in use. The city pays $5.000 per year for 100 fire hydrants and $40 per year for each one over 100. Lead service pipes are used. The population in 1880 was 10,292. The works being just finished, no statistics of consumption or finances are given.

L. H. Williams is Secretary and Treasurer of the Company, and John W. Taylor the Assistant Superintendent. J. H. Harlow is the Engineer and Superintendent.

CCCXXVI.—MISHAWAKA.

Mishawaka, Indiana, in lat. 41° 42′ N. long. 86° 12′ W., is on the St. Joseph River. It was settled about 1800 and incorporated as a town in 1836. Water-works for fire protection only were built in 1860 by the town, taking the supply from the river, which is here dammed for manufacturing purposes by a dam built in 1832, 300 ft. long and 8 ft. high.

A 16 in. Metzger rotary pump, driven by a Leffel turbine wheel, keeps the pipes constantly filled at a low pressure, which is increased in case of fire. There are 2 miles of cast-iron pipe of 8, 6 and 4-in. diameter, with 15 fire hydrants and 25 gates.

The population in 1880 was 3,500. The works have cost about $10,000, and the annual expense of maintenance is about $100. They are under the control of the Town Trustees. J. H. Whitson is the President.

CCCXXVII.—SALEM, N. C.

Salem, North Carolina, in lat. 36° 3 N., long. 80° 14′ W., is on irregular ground, on the middle fork of Muddy Creek. Settled in 1760, it was incorporated in 1854. A water supply was first introduced about 1800, a force pump being used to fill the town cisterns. In 1878 water-works were built by a private company, taking the supply from two wells 10 ft. in diameter, sunk near the creek, and pumping by water-power 150 ft. into a brick reservoir holding 90,000 gallons at 50 ft. above the city.

Distribution is by 2 miles of cast-iron pipe, of from 8 to 2-in. diameter, with 20 fire hydrants and 65 taps. The town does not pay for hydrant service. Service pipes are of wrought iron, some plain and some zinc lined.

The population, in 1880, was 1,500. The consumption is not known.

The capital stock of the company is $8,000, which is the cost of the works. The receipts are $500 per year. L. N. Clinard is Secretary of the company, and C. A. Fogle the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics as follows is acknowledged with thanks: From R. M. Wirt, secretary and treasurer, statistics of the water-works of Hanover, Pa. From James Pottie, chairman water commissioners, statistics and water rates of the water-works of Fair Haven, Vermont. From George R. Harlow, assistant engineer, statistics of the water-works of Newcastle, Penn. From G. A. Kimball, city engineer, statistics and water rates of the water-works of Somerville, Mass. From an unknown source, report of construction of works to May 1, 1880, at Peru, Ind. From Prof. R. Fletcher, Dartmouth College, statistics and water rates of the water-works of Hanover, N. H. From L. N. Clinard, secretary, statistics and water rates of the water-works of Salem, N. C. From J. H. Whitson, president, statistics of the water-works of Mishawaka, Ind. From W. Paulison, secretary Acquackanonck Water Co., statistics of the water-works of Passaic, N. J. From William H. Vibbard, sanitary engineer, annual reports of village of Kalamazoo, Mich, 1882. From M. Scannell, superintendent, water rates of the water-works of Tiffin, Ohio.

CORRECTION.—June 3, 1882, p. 179, *Lockhaven.* The lightning struck a *house*, not a *horse*.

◆

A SINGLE MERIDIAN.

At the recent International Geographical Congress held at Venice, a resolution was adopted at the instance of the American delegates asking for the appointment of an international commission, to consist of three members, to be appointed by the different governments, from geologists, geographers and men interested in commerce, "to consider the question of an initial meridian, having in view not only the question of longitude, but that of hours and dates." The reform thus contemplated is one which should receive the hearty support of our own and other governments. It is high time that a single meridian should be in use by all the civilized nations, instead of England using the meridian of Greenwich, the Germans using that of the Island of Ferro, the French that of Paris, the Spaniards that of Madrid, and America using the meridian at Washington. Much confusion would be avoided by uniting on a single meridian, while there would be a great saving in operations which are now necessary in making reductions from observations taken with reference to one meridian, so as to be comparable with observations taken in reference to another. Unification is the day, and let us have full unity on the meridian question.—*U. S. Econ.*

ENGINEERING NEWS

AND

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GEO. H. FROST......EDITOR AND PROPRIETOR.

JULIUS W. ADAMS,*
Past President A. S. C. E., } ASSOCIATE EDITORS.
S. D. V. BURR............ }

SATURDAY, JUNE 10, 1882.

EDITORIAL ANNOUNCEMENTS.

***Communications** for Mr. Adams should be addressed to Julius W. Adams, care of this journal, New York city. Articles written by Mr. Adams will be signed thus *; and only for articles so signed will he be responsible.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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CONCERNING WATER METERS.

The growing importance of the subject of waste of water in our large cities is evidenced by the carefully prepared report of the Boston Water Committee, which we publish elsewhere this week. Chief Engineer Whitman, of St. Louis, has also presented a vast array of facts on the subject to the government of that city. The engineers of other important American cities have also urged the importance of the subject, and we think it may fairly be conceded that the time is close at hand when other means than the indefinite and expensive extension of water-works will be resorted to, to insure an abundant and never-failing supply of water for all purposes, domestic and manufacturing, which our ever and rapidly increasing population and trade demand.

The cities on the great lakes, Chicago, Cleveland and Milwaukee, pumping from their great storage reservoirs, were disposed to be excessively liberal in their supply of the necessary fluid. But Chicago, with all its immense pumping facilities, cannot keep pace with the wasteful habits of its citizens, and new engines are now in process of erection, which, in a comparatively few years, will have to be added to in all probability. So it is in other large cities; bad plumbing and reckless waste are adding daily to the burdens of taxation in all cities having a public water supply, without receiving anything like an equivalent as regards improved sanitation. What this extra taxation amounts to may be computed from obtainable data as to the cost of water-works extension and their yearly maintenance. In this city an immense sum of money will soon have to be expended for an increased supply of water. We presume that if the waste were decreased seventy-five per cent. that the present facilities are sufficient for many years to come, and the same might be urged of other cities.

The Boston plan is to do whatever is undertaken in a thoroughly efficient manner. The time is so recent when a swarm of engineers and contractors were at work on an additional water supply for the city that was to be abundant for a long time to come, that a reported scarcity might well awaken a desire to try some other remedy than still other extensions. Under the direction of Superintendent Jones, of the Boston Water Department, extensive and elaborate experiments on meters for measuring water and for preventing its waste have been in progress for several months past. Last week we spent a couple of days in Boston visiting the improved sewerage works at Dorchester and Moon Island, and in witnessing the meter tests at the City Machine Shops, conducted by Mr. Dexter Brackett, Asst. City Engineer. These tests were for endurance, a stream of water under extra pressure being turned on and allowed to run till the meter gave out, thus testing the comparative strength of each style of meter. Tests for accuracy of measurement were made previously and at another station. The results of these experiments have been embodied in a paper which will soon be published in the Journal of the Engineering Association, and which is for sale by H. G. Prout, 12 Barclay street, New York. It will be illustrated with diagrams and cannot fail to be of value to all parties interested in this subject. But in conversation with a manufacturer of meters, he remarked of this testing for endurance that the best test was actual use, in which the meters were subjected to the wear and tear of large streams and small streams, high pressure and low pressure, sudden or slow shutting off, changes of temperature, etc., etc., that are the daily circumstances in the life of meters. While, therefore, Mr. Brackett's experiments may demonstrate the comparative strength of competing selected meters of different manufacturers, they cannot be considered as conclusive as against the unsuccessful ones.

We were interested in looking over the array of meters sent in for the test and not a little surprised to learn of the many different manufacturers. Upon inquiry and from personal knowledge we now know of the following manufacturers of water meters: H. R. Worthington, Union Water Meter Co., National Meter Co., Eagle Water Meter Co., Tilden Water Meter Co., Continental Water Meter Co., Desper & Co., Howe Water Meter Co., Spooner-Diaphragm Water Meter Co., United States Water Meter Co., Standard Water Meter Co., New England Water Meter Co.; we believe these are all we *now* know of, but we will be obliged for any additions to the list that may be sent us. Some of the above list are apparently mere stock jobbing schemes to wheedle the loose change of gullible investors into the hands of impecunious but wily sharpers; two of them we had to sue for our advertising bills but failed to collect even then; of a more recent concern that has a "small" supply of shares to dispose of we could find no record in the Boston Directory, the Boston Water Department had never seen even a sample meter, the President of the Company, whose name the meter bears, has been for some time in Wiscasset, Me., and doesn't know "anything about the finances of the Company." So far as we could learn the "Secretary" is a clerk in a shoe store, and the "Superintendent" was always out of the "N. Y. office" when our solicitor was in that vicinity. How the name of the wealthiest New York merchant came to be used as a card we have yet to learn. But we have amplified on this subject because we have made personal investigation on the subject of meter manufacturers, the result of which is that we find from our own inquiries and observations and from the "History and Statistics of American Water-Works," compiled by Mr. Croes that, with the exception of a few Desper meters and a few made by the New England Meter Co. of Boston, that the only meters in general use are those made by H. R. WORTHINGTON and the NATIONAL METER CO., of New York, and by the UNION WATER METER CO., of Worcester, Mass. These companies actually make meters and the *best* meters that are now in use; they do not peddle shares of stock for subsistence; they have large shops which we visited and found full of men and machinery, and all working up to their fullest capacity; their goods are known wherever there is a water supply of any considerable extent, and, with the increasing demand for meters, it is to *these three* companies that water commissioners look for their supplies. We regret very much that we were induced by our imaginative and sanguine advertising solicitors to admit certain meter stock schemes to the respectable fellowship of the above companies, and water companies may rest assured that the next meter makers that are advertised in this journal will have something more than a printed prospectus and an electrotype to found their claims to our consideration upon. We will be pleased to publish at any time the name of any *bona fide* meter company, the location of their shops, the number of men they employ, and the list of water-works using their goods. We make exception of the three firms we have already specified, as they are already too well known to need such indorsement.

* * *

OBSTRUCTIONS TO RIVER DISCHARGE BY BRIDGE PIERS.

BY GEN. Q. A. GILMORE, U. S. ENGS. VAN NOSTRAND: JUNE, 1882.

We propose to review the above paper as involving a question of some moment to hydraulic engineers, and as we have a personal knowledge of the case, will add such comments of our own as we think are called for. We regret that space will not permit more than brief quotations from the paper, or scarcely more than results, omitting, necessarily, much of the argument upon which the writer founded his selection of formula.

In 1881 the question of crossing the line of the New York, Lake Erie & Western Railroad (referred to in these papers as the Erie Railroad) by the line of the New York, Lackawanna & Western Railway (known as the Lackawanna) then under construction through the town of Chemung, Chemung County, N. Y., came before a commission at Elmira, N. Y.

The place selected for the crossing by the Lackawanna Co. is about 10 miles east of Elmira. At this point, and for some miles west of it, the Erie Railway skirts the base of the hills on the south side of the Chemung River valley, while to the eastward its track leaves the high ground and traverses the bottom lands for a distance of about 3 miles and then crosses to the north side of the Chemung River. The entire width of the valley, including the flats on both sides subject to overflow in the times of flood, varies from ½ to ¾ of a mile, and within this width the river, while pursuing its southeasterly course toward the Susquehanna, of which it is a tributary, meanders from side to side in the manner usual with streams flowing through alluvial lands. The bed of the stream, as defined by its banks at ordinary stages, has a width ranging from 400 to 500 ft., and the banks themselves are 10 to 14 ft. in height above the ordinary low river stage. The surface of the bottom lands is somewhat undulating and irregular, so that a flood rise of 20 ft. above extreme low river overflows them to a depth ranging from 4 to 10 ft., the average depth being not more than 5½ ft. With a flow of this height, the width of the river at Baldwin's (section C of plan), near the point where the railways cross each other, is 3,900 ft. Half a mile below this point to the eastward at Parshall's, the flow width was 3,200 ft., and half a mile to the westward at Briedelman's (section A) it was about 4,000 ft., but on this westerly section the highway near the ordinary river bank on the north side is not put under water by a 20-ft. rise, although the bottom land between it and the high ground to the north was submerged to the depth of 6 ft. in some places. The av erage of the widths of these three sections is

$$\frac{4,000 + 3,900 + 3,200}{3} = 3,700 \text{ ft}$$

, and may be assumed as the mean width of the stream on a 20-ft. rise for about one mile in length above Parshall's. This was the height of the flow of 1865, and which maintained its level for some hours, and submerged the Erie track to the depth of the floor of a hand car, and caused an entire suspension of the traffic on that part of the road. This was in evidence. The river at this point drains about 3,000 square miles, and at ordinary low stage of water is an insignificant stream, consisting of a succession of rippies and slackwater pools, the general slope as ascertained by precise levels at this stage being over 4 ft. to the mile. The depths in the pools vary from 4 to 10 ft. Tha discharges at low stage possibly not over 2,000 cu. ft. per second, if so much.

A narrow branch of the river, or slough, known as Parshall's Cove, about as deep as the main stream, runs in close proximity, and nearly parallel to the tracks of the Erie Railway at the point of crossing of the roads, and to the east and west of it for a distance of three-fourths of a mile, thus separating it from the bottom lands. During the flood stage, when tha flats are under water, this slough runs with a high velocity, and discharges a comparatively large volume of water; but ordinarily the only connection of the cove with the river is from below.

The Lackawanna road, approaching from the east as projected, crosses the Erie road abova grade at an acute angle of 22°, then crosses Parshall's Cove at the same angle, on a bridge of three spans of 150 ft. each (Y on plan) measured parallel to the track, giving an effective opening of only 180 ft. at right angles, to the axis of the cove, then crosses the bottom lands diagonally on a solid embankment for a distance of about 3,800 ft., to the right branch of the Chemung River, crossing that river at an angle of about 78°, with the direction of its branch, on a bridge of four spans of 150 ft. each X on plan) or an effective opening to the current of 576 ft. From the abutment on the left bank the road as projected continues on a solid embankment to the high ground on the north side of the valley.

Accepting 3,700 ft. as the average width at the flood stage of the three sections at right angles to the flood current (viz., A, C and B of plan), it will be seen that the Lackawanna road as projected leaves an effective opening in the embankment across the valley, from the high land on the north side to the high land on the south, of 736 ft., thus reducing the width of the high river waterway nearly 80 per cent.; that is, the obstruction, consisting of embankment and bridge piers and abutments, would amount to nearly *four-fifths* of the entire width in a flood like that of 1865. The effective water way, however, would not be obstructed in so great a proportion, because the bridge openings are located in the deepest water. The mean area of the three flood sections being 81.538 sq. ft., and the flood areas under tha bridges taken on sections at right angles to the current being 18.068 sq. ft., the effective waterway for a 20 ft. rise, like that of 1865, would be, obstructed 58.6 per cent. by the Lackawanna road.

The Erie road opposed the location and method of construction adopted by the Lackawanna road for crossing the valley, on the ground that so serious an obstruction to the passage of the floods would cause an increased rise or backing up of the water to such a degree that the destructive effects of the higher floods would be greatly increased, while those of ordinary magnitude, which would otherwise be harmless, might thereby be rendered dangerous and destructive. It was also claimed that there would be danger from ice gorges and that the funnel-shaped opening between the two roads above their intersection, with its base pointing up stream, rendered the accumulation of ice and the formation of an ice gorge at the cove bridge (Y of plan) highly probable.

There had been no observation taken during the freshet of velocity of current, or indeed any observations of a scientific character, and after a lapse of 16 years the only data for computation of discharge would be derived from the levels of such marks as remained legible, indicating the surface levels of tha freshet, together with the evidence of the proprietors or occupants of the land who were cognizant of the circumstances. Gen. Gilmore gives the data upon which his estimates were founded as follows:

The difference of lavel between the flow mark at Parshall's and Baldwin's (section B and C of plan) was 1.78 ft. or 3.806 ft. per mile=.0007208. This was on the flat where the water was shallow. The slope could not have been less than this in the main stream. On the contrary, it would naturally be expectad that the flood slope would be at least as steep as that of low river, *which is four feet to the mile*, and certainly as steep as that of tha overflowed bottom lands of the valley on the line of the general axis of the flood current, *which is known to be more than four feet to the mile*. The section or profile at Parshall's gives a water way of 3,200 ft. and an area of discharge of 24.235 sq. ft., for which a slope of 3.806 is taken, although, as he says, this slope is strictly applicable to the distance between Parshall's and Baldwin's, a distance of 2,400 ft. This profile he divides into two compartments—a deep one embracing the bed of the Chemung River, and a shallow one covering the flats inundated by the flood. The following is his statement:

	Width.	Area.	Hyd. rad.
Deep compartment......	500 ft.	10,752 sq. ft.	21.504 ft.
Shallow compartment...	2,700 "	13,483 "	4.9937 "
Total	3,900 ft.	24,235 sq. ft.	....

Surface slope=.0007208

To obtain the mean velocity of the sections, he selects from the various formulæ presented (all of which require as factors the surface water slope, and either directly or indirectly the hydraulic radius), the one which is the most simple, where v, the mean velocity in feet per second, is represented by a coefficient into

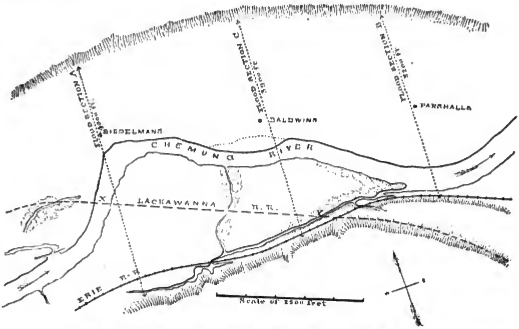
$$\sqrt{R.S}, \text{ or } v = C \times \sqrt{R.S},$$

and he assumes for C in tha deep compartment a value of 100 from Downing, and according to Young, 84.3 for tha value of C in the shallow compartment on the flats, which gives the following result:

	Mean velocity.	Volume of discharge.
Deep compartment............	12.45 ft.	133,865 cu. ft.
Shallow compartment........	5.0577 "	68,194 " "
Total..............................		202,059 cu. ft.

$$\text{Mean velocity} = \frac{202,059}{24,235} = 8.3 \text{ ft. per second.}$$

Gen. Gilmore remarks with reference to this apparently large discharge, equalling as it does during a 20-foot rise more than one fifth of the discharge of the Mississippi; that at the time of tha freshet the ground was frozen and covered with deep snow and a sudden thaw set in, accompanied by a heavy fall of rain, the stream exhibiting at such times a *not very mild type of mountain torrent*, and although the flood section of the Chemung is only about one-eighth of that of the Mississippi, its surface slope, on which the velocity and therefore the volume of discharge directly and largely depends, is about *thirty-five times as great*. Estimating the flow of the stream during each of the four hours when at its maximum height as amounting to $\frac{110}{1000}$ of an inch in depth over the entire shed, there is no difficulty in accounting



OBSTRUCTIONS TO RIVER DISCHARGE BY BRIDGE PIERS.

for the estimated discharge of 202,000 cu. ft. per second.

The vexed question of velocity upon which experimenters differ so much, is gone into by Gen. Gilmore with some detail, and reference is made to the investigations of Hagen, Darcy, Bazin, Humphreys, Abbott and Kutter, all of whom differ very materially. Bazin's formula giving in the present case a discharge of 197,673 cu. ft., and Kutter's 161,000 cu. ft. per second for a 20-ft rise.

Coming to the end and object of these investigations, viz, the backing up of such a flood, occasioned by the artificial obstructions caused by the Lackawanna Railroad, Gen. Gilmore assumes that for the purposes of this computation these constructions were located at right angles to the axis of the valley, with a clear opening at the bridges of 756 ft. This imaginary profile at flood being 31,538 sq. ft., and dividing the discharge of 202,059 by it, gives the mean velocity as 6.4 ft. per second; and hyd. rad. of the entire section being $\frac{31538}{3700}$=8.5238 ft., and the hyd. rad. at both bridges being the areas 13,068 divided by effective width, 756 ft. = 17.285, then using Eytelwein's formula of $y = \frac{v^2}{m^2}\left\{\frac{W^2 \times h^2}{w^2(h+y)^2} - 1\right\}$

where

y = increased head or backing up,
W = original width of profile in feet,
w = reduced width of " " "
h = original mean depth of profile in feet,
$\frac{1}{m^2}$ = co-efficient for contraction

he finds y=2.4272 ft., as the rise occasioned by such a flood, or by using the formula given by Debauve *Manuel de l'Engenieur des Ponts et Chaussées* of $y = \frac{Q^2}{2g}\left\{\frac{1}{m^2 w^2 h^2} - \frac{1}{W^2(h+y)^2}\right\}$ with the same notation as above, except, taking the coefficient of contraction m = .90, and Q equals volume of discharge in cubic feet per second, he obtain y = 4.3168 ft. as the increased head.

Taking the formulæ of Bazin, Humphrey and Abbott and Kutter for velocity, and applying the respective results to Eytelwein's and Debauve's formula for rise, the whole are shown in the following table:

FORMULÆ FOR VELOCITY.	Volume of discharge c.ft.p'r sec. Q	Formulæ for rise.	
		Eytelwein.	Debauve
		Feet.	Feet.
D'Aubuisson & Downing.	202,059	2.4272	4.3168
Bazin.	197,673	2.3474	1.1113
Humphrey & Abbot	131,573	1.2092	1.7587
Ganguillet & Kutter.....	161,010	1.0968	2.6775

In arriving at the results of the above tabular statement, Gen. Gilmore has specified minutely the locality of the cross-section which he uses in his calculations, as also the data furnished him in reference to the flood-marks of 1865, and likewise the various hydraulic formulæ which engineers have hitherto regarded as applicable to such calculations, and has given also his application of this data to the various formula at each and every step, with a thoroughness much to be desired in the case of disputed authorities; and his personal experience in the behavior of great rivers in flood, having been for years on the Mississippi River Commission, entitle his opinions to great weight in the premises. It will be observed that he estimates the rise in such a flood, occasioned by the given obstacles, as from 1.2 ft. to 4.3 ft., according to the authority which may be accepted as applicable to the case, the data at his command being the flood section and the surface slope. The results obtained by him were combated by the expert upon the part of the Lackawanna road, upon the ground that the topographical features of the locality combine to render utterly unreliable any attempt to ascertain the discharge by computation from cross-section and slope.

One of the experts called in the case, using D'Aubuisson's formula of $v = 94.7\sqrt{RS} - 0.11$, made the discharge to be 169,411 cu. ft. per. second, which he considered too large, and then considering the highest known flow of the Merrimac River to have delivered but ¾ of an inch in twenty-four hours over the entire shed, and computing the delivery from the Chemung shed of 2,770 square miles to be at the same rate, it would give but 55,860 cu. ft. per second; and regarding this as too low, and having no better guide, took an average of the two, or 112,652 cu. ft. per second, as the discharge of the Chemung in the freshet of 1865.

Not being in possession of the characteristics of the Merrimac, we will show, by reference to the Connecticut, how far the discharge of one river may be taken as a certain guide for another without reference to their respective peculiarities. The report of General Ellis, made to the United States Government, of his gauging of the Connecticut River for some years, shows a water-shed of over 10,000 square miles, and a flood discharge of 212,000 cu. ft. per second. The flood slope of this river for 36 miles above Hartford to Holyoke Falls was at the rate of 1.1 ft. per mile, while the flood slope of the Chemung river of little less section for the same distance above the proposed crossing, is 4 ft. per mile!

This fact, as also Gen. Gilmore's supposition, given above, of the discharge from the Chemung water-shed, under the circumstances named, of $\frac{1}{10}$ inch per hour for the maximum duration of the flow, will show the value to be attached to such loose comparisons of river discharges. After citing the Potomac and Kanawha river discharges without reference to their slopes, the expert on the part of the Lackawanna road, from the discharge of the rivers cited, claimed that the valley at the site of the crossing was not a proper place to furnish the data for a computation of discharge—that the varying direction of the main river channel, which carried nearly half the entire flow, winding through, crossing and recrossing a valley whose general direction was nearly straight, its banks fringed with trees, the surface of the valley (a plain) obstructed by masses of woods and detached trees, and to some extent by houses, fences and the like—would so far hinder the flow of the water and increase its surface slope as to render any computation valueless which was based upon measurements made at that place. He accordingly goes some ten miles up stream, and selects the bridge crossings at Elmira, of which there are three of varying lengths, and a mill dam, all within a distance on the river of little over half a mile, and condemning the Downing-d'Aubuisson formula, "as incapable of correctly representing the flow of water in open channels, and its results as not worthy of confidence," proposes to make up for the paucity of data in his possession, by a little more intricacy of formula, and claims for the Kutter formula

$$v = \left\{ \frac{41.6 + \frac{1.1811}{n} + \frac{.00281}{S}}{1 + \left(41.6 + \frac{.00281}{S}\right)\frac{n}{\sqrt{R}}} \right\} \sqrt{R\,S}$$

all attainable accuracy.

This formula has a decided look of precision about it, but we submit, with all due deference to better judgment, that no more than any other formula will it insure correct results from insufficient or loose data.

We are not in possession of the notes or data used by this expert on the part of the Lackawanna road at Elmira—whether he used one bridge or all three—or the slope resulting from the combined obstacles of the locality, or finally, what was the degree of roughness allowed in the Kutter formula for the bed, but the resulting discharge of the river at that locality was given as 72,815 cu. ft. per second.

It seems with all this care to introduce an accurate formula, a simpler one might have served the purpose as well, for it appeared subsequently that the entire flow did not pass through these bridges, but overflowed the banks above and broke through the railroad bank, and ran down in another channel. It was therefore not included in the computed discharge above stated, nor was there any obvious way to measure it. It was finally estimated by some common sense process without recourse to Kutter, as amounting to 6,105.13 cu. ft. per second, and adding it to the 72,815, and increasing the total in the ratio of the drainage area at the crossing ten miles below, to the drainage area above Elmira (the character of the respective mountain torrents intervening between the localities being wholly ignored), a total discharge of 91,547 cu. ft. per second was claimed as the probable maximum discharge of the flood of 1865 at the Chemung crossing, *ten miles to the eastward*. Subsequently, on rebuttal, it was proved that there was still another escape of freshet water at Elmira, which had been neglected in making the above estimate, and, failing any other method of estimating it, the quantity was computed by the formula for the discharge of weirs, and increasing this again in the ratio of the drainage areas, gave 3,500 cub. ft. per second to be added to the above, making the total 95,000 cu. ft. per second.

Having by this truly scientific method overcome the objection to using sectional area of flood discharge and slope of surface at the point in controversy, and arrived at the discharge at the latter point by estimating it elsewhere, and guessing at the margin to be allowed for a change in longitude, he computed the rise occasioned by such a flood as that of 1865, or with 58 per cent. of the natural water way obstructed, as but .568 of a foot!

The endeavor was made to prove before—or by this commission, that the acknowledged rise of water, which at the point of controversy had laid the Erie railway track some 2 ft. under water for several hours, was occasioned by the *wave* produced by the giving way of the State dam above Corning 28 miles distant; and as the dam was no longer in existence, no such effect was to be anticipated in the future, and hence no precautions were called for. The evidence was so conflicting as to the extent of the breach in the Corning dam, and the length of time which took place before the pool above this dam had subsided a given amount, that no definite conclusion could possibly be arrived at, as to wave effects thereby produced below. The pool above the dam was some 470 acres in area, and the witnesses to the break of the dam, on one side, averred that the water in the pool above fell 4 feet in about 1¾ hours, and on the other side they were equally positive that the breach in the embankment was only 10 or 12 ft. wide; that the dam was drowned out, the water on both sides being about level with the top of the guard bank; that the water in the pool above did not fall after the break, but was somewhat higher later in the day. Let this be as it may; as the water remained at its maximum height 28 miles below for *several hours*, there could have been no movement of the water at that point in a river of these dimensions at all analogous to a *wave;* and the facts stated in support of the wave theory, that in the artificial navigation of the river Yonne in France, impounded water starting with a height of 3 ft. was 2 ft. high at the junction of the Yonne with the Seine, and one foot high at Paris, 60 miles below, gives no support whatever to this wave theory at Chemung, as there was no comparison in the width of river, the surface slope, the depth or duration of maximum height in the two cases, although it was considered on one side as establishing the *probability* that the wave increased the height of the water at Chemung about one foot.

In the official decision of the Commission in this case, the statement is made that the expert on the part of the Lackawanna road, in addition to his computation of the discharge of the river at Elmira, also made a computation by using a section or sections near the point of crossing, by which the volume of discharge was estimated at 99,000 cu. ft. per second, approximately, but the language is so obscure that we are unable to define precisely what sections these were or any of the data used in the computation, and are, in consequence, confined to the simple statement of the result. The Commission then give their decision, from which we quote as follows: "That the volume of discharge was about 100,000 cu. ft. per second, and after making all allowance for the excess of that flood over all other known floods, *and for the effect of the break in the Corning dam during that flood of* 1865, they determined," briefly and with reference to this hydraulic question, that an opening shall be made in the bank west of the Chemung River bridge, and immediately adjoining it, of not less than three spans of 134 ft. each in the direction of the flood current, or 405 ft. additional opening.

What was the calculated rise of backwater which this additional opening or water way through the embankment, equivalent to 8,100 sq. ft. would reduce to zero, is not stated by the Commission, and it would be idle for us to attempt the solution with so wide differences as those assumed for the data of the calculations of the several experts.

We do not think this Commission has settled any contested principles or practices of engineers in the computation of flow of water in open channels. Great stress was laid upon the inapplicability of the hydraulic formula in general use until within a very few years, and it was claimed that the Kutter formula alone was worthy of any confidence. It is undoubtedly a valuable contribution to our stock of hydraulic formula, and we would not attempt to weaken confidence in its use, but, like all other formula of like purport, it must be used with discretion, and with some reference to the experiments upon which it was founded. In the present case, here was a stream that ordinarily carried less than a couple of thousand cubic feet of water, suddenly called upon to discharge nearly, if not quite, a hundred times as much. No one will pretend to say that the Kutter formula had been built up by any such experience or observations; and in searching for a formula expressive of the governing circumstances of the case—simplicity would be first requisite, coupled with a recognition of the broad principles which philosophers and engineers for the last hundred years have borne testimony to as underlying the whole subject. We allude to the law of falling bodies, the accelerating force of gravity on an inclination, and the retarding effect of the wetted perimeter, qualified by the greater or less volume carried in the section. This, combined with a factor expressive of the frictional resistance of the channel and deduced from experiment, is the expression from which, by reduction, we derive the simple formula of the mean velocity equaling the square root of the mean hyd. radius, and the mean hydraulic slope, *multiplied by a variable coefficient*, or

$$v = c\sqrt{R S}$$

A writer in "Engineering,"* taking the different authorities for the use of this formula, shows the following values adopted by them for the coefficient.

Young, for large streams	c = 84.3
Neville river velocity, < 1. 5 ft	c = 92.3
" " " > 1. 5 ft	c = 93.3
Eytelwein, generally	c = 93.4
Beardmore, open channels	c = 94.2
Stevenson, for streams of 30 c. ft	c = 69.0
" " rivers 2,500 c. ft	c = 96.0
Leslie, small streams	c = 68.0
Downing, Taylor, D'Aubuisson, for open channels	c = 100.0

and comparing the results of the above formula with known discharges, he states that the coefficient of 100 gave *too small* results in cases where the areas exceeded 7,000 sq. ft. with a mean velocity of 2.5, or a discharge of 17.500 cu. ft. per second, and too large results for cases of smaller section. That the Eytelwein coefficient, 93.4, in the same way is too small above and too large below, a discharge of about 2,000 cu. ft. per second; and the Young coefficient, 84.8, is incorrect for everything above 900 cu. ft. per second; also, that for small streams of 25 cu. ft. a coefficient of about 60 is tolerably accurate, and adds: "It is evident then that with a large number of cases of carefully measured discharge, this principle of determining practical coefficients, in relation to approximate volume or velocity, might be carried out to further exactness, and it is very desirable that this should be done."

Special argument in support of the value of Kutter's formula for all cases of open channels, having in view as a factor, and introducing into the coefficient c. an expression for the roughness of the bed of the stream, will be found in a forthcoming number of the Transactions of the A. S. C. Eng., and which should have found place here with the review of Gen. Gilmore's paper as part of the proceedings before the same Commission, and of general interest in that connection, but it would have anticipated the publication of the former paper in the Transactions of the Society to which it was addressed, and through which alone it can properly reach the public. When it appears, a complete answer and refutation of the claim of the Kutter formula to *universality of application* in its present shape will be given in the republication from the Transactions of this same Society, of a paper by Gen. Theo. G. Ellis, of Hartford, who has made the subject of the flow of large rivers a special study for several years past in the service of the U. S. government, under circumstances giving great advantages for the elaboration of sound theoretical as well as practical views.

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SECONDARY BATTERIES.

Long ago it was observed that if the current from a pile was passed through a voltameter—two platinum points immersed in a jar of acidulated water—a decomposition of the water resulted, depending in its violence on the strength of the current. If this circuit was broken, and the two wires leading from the voltameter joined to a detector, or galvanometer, a deflection took place showing that there was a reactionary movement in the voltameter itself. Later experiments were made to show that this secondary current moved in a direction contrary to that of the exciting current. Almost any elements, placed in a proper conducting medium, will yield a secondary current after having been subjected to the influence of a battery. Up to the present time lead in dilute sulphuric acid has been found to produce the most satisfactory results, and it is our object in the following remarks to examine the causes which produce the second current and also to see if the factors of loss are so great as to seriously interfere with the practical application of the apparatus.

In no sense whatever is the secondary battery an accumulating or storing battery of electricity—electricity has not yet been bottled, and never will be unless it happens at the same time that all motion is caught and caged. We know that the appelations were first used figuratively, nevertheless they should be expunged. So far as the subject is known at present electricity seems to be a motion of the atoms constituting the medium through which it acts, and is itself created by a motion which may be mechanical as in the dynamo or the outcome of chemical action as in the pile.

Another fact in regard to electricity is what has been aptly termed its "interchangeableness." By power we move a dynamo and generate a current; by sending a current through a dynamo we obtain a motion convertible into power. Atomic motion in a battery produces a current; conversely a current produces decomposition. In the first instance the greater the amount of power expended the greater will be the result; the same is true of the next, the more intense the chemical affinities the greater will be the effect.

In the Faure secondary battery the exciting current produces a decomposition or change in the lead elements which will result in a recomposition upon its cessation. The plates are covered with an oxide of lead, and immersed in dilute sulphuric acid. No chemical affinity being present, there is no action, and it now becomes the duty of the electric current while passing through the battery to so change the elements that there will, upon its stoppage, be such a chemical action as will produce the secondary current. The oxide of lead manually placed on the plates and held in position by coverings of parchment undergoes a change: that on one element becomes a peroxide, while the oxygen from the other leaves it, and the spongy mass of lead is the result. We now have in the battery after the action has ceased two elements immersed in a suitable medium, which have a strong chemical affinity for one another. From this point the action of the battery is essentially the same as that in any chemical pile; oxygen from the peroxide element is liberated; the reduced lead is recomposed and becomes the oxide just destroyed, the result being the redeveloping of a portion of the current of electricity which was required to produce the change.

In this, as in any battery, the strength of the current and its duration depend upon the violence of the chemical action and the superficial area of the elements. Also, as in other cases, if a rest be allowed after the current has weakened from continuous action, a large percentage of the strength of the first current will be perceptible in the second. This is for precisely the same reason as the recovery in the ordinary battery.

The commercial success of batteries constructed upon this principle will depend upon the cost of manufacture, size and economy. The cost of manufacture is comparatively small, and as the destruction of material is also small, the question may be omitted at present. The size is a great drawback, and until it is reduced most considerably it is not probable that secondary batteries will be located in residences and taken in wagons daily to a central station to be "charged." The actual cost of running is the most important factor in the problem, and as the steam engine may be taken as the generator, the question will be, ultimately: How much electricity can be obtained by the consumption of one pound of coal? As the losses from the method of burning the coal, from the engine and from the dynamo are the same for the secondary battery as for the dynamo current direct, we will only consider the loss occasioned by the use of the battery.

It is a well-known, though often disregarded law, that the nearer the work can be done to the generating power the greater will be the effect obtained. The nearer coal can be burned to the pit's mouth the less will be the cost of manufacture; the nearer a lathe can be run to the engine the smaller will be the cost of running that lathe. Every additional operation, every moment of time and every foot of distance intervening between the cause and effect produce additional cost. In this instance what is applicable in mechanics is pertinent in chemistry.

In secondary batteries there are many steps, at each one of which a little is taken from the final result. All the current from the dynamo cannot be utilized in producing the chemical changes; the time intervening between the periods of charging and using causes a loss; the final chemical action will not produce even an amount of current equal to the initial current minus the loss in charging and the time. Something is lost at each step, but just what percentage of the whole has not yet been determined.

The results of a series of experiments carried on at the Conservatoire des Arts et Métiers at Paris form the most authentic account yet obtained of the working of these batteries. They were charged by a Siemens dynamo machine, careful note being made of the required power. The resulting current was used to light the Maxim incandescent lamp, and the return of the cells was about 90 per cent. considered as electrical quantity. But in respect to work done, it was demonstrated that the battery returned only 40 per cent. of the amount required to charge it, and 60 per cent. of the energy actually stored up by it. This refers only to disposable electric energy. It is probable that if the current had been transformed into mechanical work the amount would have been smaller. The power required to charge the battery was equivalent to one horse-power acting during thirty-five hours and twenty-six minutes; only 66 per cent. of the work expended was received by the battery, and only 60 per cent. of this was given back by the battery.

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* Van Nostrand's Magazine, 1873, p. 320. article, Hydrodynamic Formulæ.

THE DURHAM SYSTEM OF HOUSE DRAINAGE.

There is now on exhibition at the office of ENGINEERING NEWS full-sized models of a new system of construction for house drains, the invention of C. W. Durham, Member American Society Civil Engineers. In this system all of the ordinary plumber's materials and fittings are discarded, and in the construction of the work the plumber's services are dispensed with. To secure an invulnerable connection between the water closet and the street, which shall be permanently independent of malicious or accidental damage from carpenter's nails, settling walls or the numerous causes which operate to render a first-class job of plumbing insecure even before a building is ready to be occupied, the principles of gas and steam engineering are employed. Wrought-iron steam pipe, thoroughly coated inside and out for protection from rust, with screw joints, takes the place of thin cast-iron, plumber's soil pipe; and for the drain heavy cast-iron water pipe, with heavy lead joints calculated to be gas tight under a pressure of 800 pounds to the square inch is used. The soil pipes are screwed into the drain and stand erect without lateral support, not being clamped to walls as required by plumber's soil pipe; and water closets are supported directly from the rigid soil pipe without resting on floors. The entire drainage system is independent of the building for support, and consequently unaffected by settlement or racking, while the weight and character of the materials employed insure durability and security against every contingency. The principle of solid and perfect mechanical construction, combined with thorough ventilation, recommends itself to the common sense of every thinking person as a correct solution of the drainage problem.

This system to the present time has been available only to the public in the Northwest, where it has been placed in over 700 buildings. A company is to be organized in New York to manufacture the material and construct house drainage throughout the Eastern States, and as this system has the professional endorsement of Mr. E. S. Chesbrough, Consulting Engineer to the City of New York, and all other scientific authorities who have examined it, the public can confidently assume that the adoption of the Durham system will make their dwellings secure against all possibility of sewer malaria, not for a year or two years, but for a lifetime, or more correctly, a building's life time.

At the Sanitary Exhibition, at South Kensington, in 1881, the system received the only award for improvements in the construction of house drains from a jury of men the most eminent in their profession.

PERSONAL.

MR. A. J. CASSATT, First Vice-President of the Pennsylvania Railroad, will soon resign that position in October.

SAMUEL M. GRAY, City Engineer of Providence, R. I., has been appointed a member of the State Board of Health.

F. J. PICARD has been elected general superintendent and chief engineer of the Columbus & Maysville Railroad.

COL. F. J. PICARD is General Superintendent and Chief Engineer of the Columbus and Maysville Railroad, with office at Hillsboro, O.

F. C. HAND, recently of the Denver and Rio Grande Railroad, has been appointed Chief Engineer of the San Pete Valley Railroad, with office at Wales, Utah.

DR. WM. MCFADDEN, Chief Engineer of the Philadelphia Water Department, was asked to resign by a 16 to 9 vote of the Councils Water Committee on the 6th inst.

MR. T. H. LEWIS has been appointed Inspector of Track, Bridges and Buildings on the Northern Pacific Railroad, with office at St. Paul, Minn. Mr. Lewis is a graduate of the Towne Scientific School, University of Pennsylvania, and his last position was as assistant to Mr. F. Stataper, Chief Engineer of the Pennsylvania Company.

"DR. A. B. ELLIOTT, our new American Consul, is an intelligent gentleman of about sixty years," says the *Dundas County* (Canada) *Herald*, referring to the well-known proprietor of the Lansingburgh (N. Y.) *Gazette*. "He is a veteran editor and writer, and an effective public speaker of wide celebrity in the United States. We are authorized to state that the recent letters purporting to have been written by him are fabrications."

PRESIDENT ELIOT, of Harvard, has that last best gift to man—tact. At one time his students developed an unpleasant liking for sitting in large numbers upon the fence that surrounds the college yard. The President, not desiring such a thing to become a custom, was at a loss how best to break up this practice. At last, one evening, as he was walking along the sidewalk, and the students were sitting on the fence singing, etc., the president said: "Gentlemen, allow me to congratulate you on having adopted the Yale custom." He was never troubled afterward by students sitting on the fence.

ENGINEER CORPS CHANGES.—The following changes in the stations and duties of officers of the corps of engineers are ordered: Major William H. B. Benyaurd, to Chicago, Ill., to relieve Major Garrett J. Lydecker of the charge of the works under his direction in the State of Illinois. Capt. Alexander M. Miller, to Memphis, Tenn., to relieve Major William H. H. Benyaurd, who will repair to his new station at Chicago, Ill. First Lieut. Henry S. Taber, to Fort Snelling, Minn., to relieve Capt. Edward Maguire as engineer officer of that department. First Lieut. James L. Lusk, to Mobile, Ala. The following named officers will be relieved from duty with the battalion of engineers by the commanding officer of the battalion, and will report as follows: First Lieut. Frederic V. Abbott to Major Oswald H. Ernst, at St. Louis, Mo., for duty under his immediate orders. First Lieut. Thomas L. Casey, Jr., to Capt. William Ludlow, at Philadelphia, Pa., for duty under his immediate orders. Second Lieut. Curtis McD. Townsend, to Lieut. Col. William P. Craighill, at Baltimore, Md., for duty under his immediate orders. Second Lieut. Gustav J. Fibeger, to Whipple Barracks, Prescott, Arizona Territory, to relieve First Lieut. Carl F. Palfrey as engineer officer of that department. First Lieut. Carl F. Palfrey, to San Francisco, Cal.

ENGINEERS AND ENGINEERING IN OTHER LANDS.

(Specially Translated and Prepared from Our Exchanges.)

There is a great deal of talk at present among French engineers of the reorganization of the Corps des Ponts et Chaussées. Not only the engineers themselves complain, but the great body of aids, and what we generally term "chainmen," a goodly army of 6,000. Promotions, too, in this body have been going at the pace of a snail—and of a blind one, too.

The Cologne *Gazette* has another letter especially about engineers employed on the canal. As it will doubtless be interesting to American engineers, it is here literally translated "Gamboa." Of the engineers employed on the Panama Canal, those who occupy high positions passed through the usual State examinations in that country. A few of them were already in Lesseps' service in cutting the Suez canal. In the beginning, great care was taken in selecting the engineers, and a great many English, North Americans and Germans were for this reason refused. After a little while, however, it was perceived that the necessary supply of intelligent, venturesome and hardy men could not be procured from France alone, or that it would not be to the advantage of the canal if so. As conditions now are, I believe that a position would be given to any engineer who could prove his capacity—equally whether he had passed an examination or not. The management cannot be blamed, however, for being cautious in the matter. An instance has been seen here in which a builder, who gave himself out as an experienced one at least, and who received a very remunerative and easy post on account of his agreeable manners, did not know anything about the use of a leveling instrument, and, in all probability, had never even seen one.

The salaries paid the canal engineers are high, from a European standpoint, but then the danger of the climate must be taken into consideration. The European overseers receive from $100 to $150; the ordinary engineers from $125 to $250, and the Division overseers and other high officials from 400 to 500 dollars. [This, in German money, is from 1,600 to 2,000 marks—and sounds big, very big! *Trans.*] American and English, who are not looked upon as being too friendly to the undertaking, consider these salaries as being even too low on account of the climate and cost of living. It would seem to me, however, that the gentlemen who are engaged at such isolated places as Emperador, Gamboa, Gatun, etc., where there are no occasions for great outlay, could very well lay by something handsome. The high prices are only for Panama and Colon, while those engineers who live in out-of-the-way places can build small rent-free houses and have provisions very cheap.

Very few of the houses put up by the company for their engineers are in brick. American woods, planks, etc., all ready cut, have been shipped from the United States. All, or mostly all, are of one story and built on posts. Still they have quite a cheerful appearance, with their green blinds and carved work. It is purposed that later every engineer shall have his own house, containing two or three rooms. The great objection to these houses, at present, is that unless they are provided with wide, projecting roofs, they are almost untenable during the great heat of the day. At night, however, the wind often sounds shrilly through the crevices. In Emperador I saw flower-beds and European vegetables, especially peas and beans. In Gamboa you will find Mr. Carrey's house with baths, mirrors, books and all the articles of modern luxury that a young bachelor can desire. In Gatun Mr. Sharp has a similar house; it is situated on a height, and in case of trouble from a strike, etc., could serve as a fort. All the palm trees, I was happy to see, have been left standing when not strictly in the line of the canal. Mostly all the engineers have a cook for them when living in the same place. To tell the truth, there is not only a great dearth of cooks and female servants here, but of women in general, and most of the engineers are unmarried. We have wines, preserves, etc., from Panama free of duty, and at wholesale prices. As a beverage Vichy water is in great favor, although good water can be had. There are cantines with billiards—places also patronized by the workmen. The prices are low in Gatun. You can have a nourishing dinner, half a bottle of Bordeaux wine and coffee for 70 centavos. The French seem to know how to take care of themselves better, in so far as domestic matters are concerned, than the English and Americans. There are no amusements except what the engineers can provide for themselves, and the danger of giving themselves up to drink is very great. The company will soon allow $40 monthly for a horse, but at present there are hardly any. To show how various are the nationalities employed here, the list of the engineers at Emperador may be given. The division superintendent, M. Jacquemin, who was previously on the Suez Canal and who lives in Panama with his family; Herr Berns, the second division superintendent, is from the Rhenish Province—he worked formerly under Meiggs on the Oroya Railroad; Mons. Lebeau is a Parisian, M. Merciér a Swiss, M. Dreyfus an Alsatian, and there is a Vienna gentleman, whose name I forget.

Now, that there will soon be very evidently a lull in the building of railroads in this country, let us hope there may be room for a few of our engineers—in case they require positions—in the construction of the great works in the East. We shall allude to these more in detail in future numbers of Engineering News, but we may add to those mentioned in our last letter—the cutting of the Straits of Malacca, and the cutting of the Isthmus of Corinth—the latter has just been begun under the direction of General Turr. It would seem that there is a surplus of German engineers just at present, although a large number have lately been engaged in Turkey, where it seems German influence is now in the ascendant. But there is really no reason—except financial ones—why Americans should not pay some attention to the great works which the changing of the transport trade and general commerce of the world are now making necessities.

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CORRESPONDENCE.

CORRECTION.

New York, June 6, 1882.

Editor Engineering News:

However "pleasing (it may be) to see one's name in print," yet it it is unpleasant "to have one's name mis-spelt in a bulletin."

The notice you gave of my report on the columns and ceiling of the Assembly Chambers of the Capitol at Albany was but an extract from an Albany paper, with all its faults of typography full upon it.

The notice made it inferential that I had volunteered my opinion, whereas I was summoned in due and ample form to appear at Albany and give my opinion in the matter.

I inclose you a fair copy of the report, should you see fit to correct your notice.

Respectfully,

Chas. H. Haswell.

[We publish the report as sent by Mr. Haswell, but we fail to see where the errors of mis-spelling or other wise, in our notice of last week, on page 185, "come in," except that he is called "superin*tending*" engineer from the card on his envelope, instead of "supervising," from his card on his note head.—Ed. Eng. News.]

THE CRUMBLING ASSEMBLY CHAMBER.

Engineer Haswell Certifies that the Supporting Piers have Settled.

Albany, May 30.—Assemblyman Benedict has made public the following letter, which confirms, although in guarded language, the opinions already expressed by Federal engineers relative to the instability of the costly Assembly Chamber in the New Capitol.

Office of Chas. H. Haswell,
Consulting and Supervising Engineer
and City Surveyor,
New York, June 6, 1881.

Sir: In compliance with your summons I have visited the Capitol building and have examined the ceiling of the Assembly Chamber in its construction and condition, together with the piers sustaining the columns, supporting it. I submit:

The piers have settled, and the integrity of the ceiling is disturbed.

The circumstances that it has been deemed necessary by those fully acquainted with all the elements of the designs, support and structure of the ceiling, to supplement it with a counterpoise and counterfort, would seem to be conclusive that it is admitted to be defective either in design or construction, or both.

In the absence of a base of reference and an instrument of application thereto, it was impracticable for me to arrive at the extent or conformity of the settling of the piers; and in the absence of a copy of the drawings whereby to determine as to the nature and extent of the lateral resistance to thrusts of the ceiling, it was alike impracticable for me to decide upon the general character of the thrust.

Reviewing the elements presented, I am of the opinion that the subject is one involving early attention, and in order to ascertain to what extent and in what manner remedial action is best to be applied, I suggest that it be submitted to the consideration and report of a Board of Engineers and Architects, and if remedial action should be recommended and adopted, that this opportunity will be presented to very materially improve the acoustics of the chamber.

Respectfully,

Chas. H. Haswell.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Settling the Difficulty at Cambridge, Mass.—The Water Board has unanimously adopted the following:

Resolved, That after a careful and patient investigation of charges made against Hiram Nevons, Superintendent, by John Miller, foreman, the Water Board decides that the charges made are without foundation, and in no way reflect on the good character or capacity of Mr. Nevons.

Water-Works for Butte, Montana.—The Water Company's men, along the east side of Montana street, have run the preliminary stakes for the 8-in. main down as far as Park. At the northeast corner of Park and Montana streets the line will be run west across Montana street and down by the Caplice building. On the west side only a 2-in. pipe will be put in, room being left on the east side for the extension of the 8-in. main whenever it is thought desirable. In the meantime residents of the southwest quarter of the city may hope for a plentiful supply of water now in a few weeks.

Water-Works Wanted.—Woodbury, N. J., wants a water-works. The City Council has under consideration an offer from John Lockwood, of New York, to build a works at his own expense, put in the most improved pumping machinery, capable of supplying 750,000 gallons of water daily. He will also build a reservoir with a capacity to contain not less than 1,000,000 gallons, and lay three miles of water pipes, and at the expiration of ten years agrees to sell the works to the city.

The town of Northborough, Mass., last week voted almost unanimously in favor of water-works. The water is to be taken from Boylston and Shrewsbury, some three miles distant, and Messrs. Goodhue & Birnie of Springfield offer to construct the water-works for $50,000. The choice of Water Commissioners was deferred.

Improvement at Pittsfield, Mass.—A new six inch iron water main is being laid in Depot street in place of the old four-inch cement pipe.

New Water Company.—Denison, Texas, has a water-supply company. Capital stock, $100,000.

Reservoir Completed.—A dispatch from Sedalia, Mo., dated the 3d, says: During the past week the new dam and reservoir of the Sedalia water-works has been completed and thoroughly tested as to strength and capacity. The city now has a supply of water amply sufficient for a city of 50,000 people. The back water of the dam extends in the bed of the stream for a distance of nearly two miles above the dam, and has an average depth of six feet. The dam cost $10,000, and the supply of water for the city is now assured beyond all contingencies.

Water-Works at Laredo.—From the *Daily Express* of San Antonio, Tex., we clip the following: Mr. Freeman, of this city, has returned home from Laredo where he made a survey of the contemplated water-works. He approves the water-power as located and established by Brune for the purpose of generating electricity for lighting the city and lifting water into the reservoir. He says the power can be increased, with a little additional expense, to three hundred horse-power. Every arrangement is being made, and an early completion of the much needed work is an assured fact.

Malden, Mass., has voted $7,500 to be expended in extending its water-works.

Water Supply of Paris.—The scarcity of water from which Paris suffered last summer is likely to be repeated during the present year. The winter just past was a period of exceptional drouth, and the results of it are not confined to the basin of the Seine. In eastern France the situation is especially distressing. At Kehl the bed of the Rhine is dry in places; the Meurthe was never before so low even in August, and the level of the Moselle and the Meuse has fallen.

Gas Tanks.—The National Tube Works Co., Pittsburgh, are building a cluster of gas tanks for harbor lights for the Beacon Light Co., of Baltimore.

Again Agitated.—Philadelphia is again disturbed in regard to the pollution of the Schuylkill.

The Reading of Gas Meters.—A very valuable application of their counting machine has been made by T. R. Harding & Son, Tower Works, Leeds, and one which will no doubt become of universal use. Every one knows how difficult it is to check the reading of gas-meters, and how liable gas-consumers are to be charged for more gas than they believe they have burnt. Messrs. Harding have, after long and persistent experiments, succeeded in making a counting machine at so small a sum as to be able to compete with the index at present in use. By this machine every single foot of gas burnt will be separately registered, and anyone (even a child) can read the figures, and can tell how much gas has been burnt in a given time. The Gas Committee have ordered a number of these indices to be attached to meters for testing, and in due course all meters in Leeds will probably have this "ready reckoner" upon them.—*The Ironmonger.*

The Joplin, Missouri, Water-Works Company is putting up a new stand-pipe reservoir. The commissioners appointed upon the petition of the Commissioner of Public Works to appraise the value of land needed for the construction of a new reservoir at Kensico, Westchester County, and of a pipe line or aqueduct, have completed their work. The land to be acquired under this report adjoins Big and Little Rye ponds and the streams flowing out of them. These ponds and streams will yield 1,000,000,000 gallons of water, which will be stored in the new Kensico reservoir.

Kerosene Instead of Gas.—An exchange says: Keokuk has discarded gas and made a contract for lighting up their city with kerosene oil at the rate of $16.50 for each lamp-post per annum.

ELECTRICITY.

Gas vs. Electricity.—The great multiplication of telegraph, telephone and electric light wires has caused a large increase in the expenses of insulators, and to meet this difficulty English inventors have introduced a cheap insulating material called insulite. A method has been discovered by which wood, sawdust, cotton waste, paper pulp and other fibrous materials can be converted into a material perfectly impervious to moisture and acids, easily molded under pressure to any shape, and capable of being worked or cut into any form. The material is an excellent non-conductor of electricity, and can be used for all forms of electrical machinery.—*Ex.*

New Telegraph Company.—The Baltimore & Ohio Telegraph Company has filed a certificate of association at Albany, N. Y. The general route of the lines is from New York to Brooklyn, thence across New York Bay to Edgewater, through Richmond County to or near Tottenville. The capital is $100,000.

Secondary Batteries.—Prof. S. P. Thomson has found that almost any oxide of hydrate of lead will serve in the Faure battery. Litharge will do if it is so finely ground as to be painted on the plates. He obtained the best results by coating the plates with the brown peroxide, but it is a little more expensive than red lead or litharge.

A narrow-gauge electric railway in Fairmount Park, Philadelphia, is proposed. Ex-Gov. Hartranft is one of the promoters, and $200,000 is the capital to be solicited.

Electric Lights in Rhode Island.—An important act passed the General Assembly, which will seriously affect electric lighting and telegraph companies. Several acts were introduced for the incorporation of electric-light companies, but the committee to whom they were referred inserted a clause by which city and town councils may order poles and wires down after a formal notice of 30 days.

STREETS, DRAINAGE, ETC.

Ditches.—Wabash County, Ind., is building $100,000 worth of ditches.

Atchison, Kan., is debating as to whether or not she should borrow $15,000 to fix her streets.

RIVERS AND HARBORS

Harbor Improvements in Wisconsin.—The harbor improvements at Menominee this year will necessitate the expenditure of $15,000. Five new cribs and the superstructure over six others will be built; also, repairs to one displaced crib.

Des Moines Dry Dock.—Washington, D. C., June 5.—Representative McCord, of Iowa, to-day introduced a bill appropriating $30,000 for the construction of a dry dock at the Des Moines Rapids Canal on the Mississippi River. The bill was accompanied by letters from the Chief of Engineers and the Secretary of War, advocating strongly the appropriation for the purposes desired.

RAILROADS.

Widening the Road.—The Circuit Clerk, of Jo Daviess County, Ill., has recorded a mortgage for a consideration of $620,000 in favor of the Farmers' Loan and Trust Company and against the Chicago & Northwestern Railroad Company, to raise funds to widen the narrow-gauge railroad from Galena to Woodman, Wis., and branches to Platteville and Lancaster, Wis., a distance of 92 miles. The work is already under way and the traveling public will be rejoiced to learn that there will soon be a northwestern broad-gauge connection between this city and Milwaukee and Chicago.

Buying a Railroad.—The Northern Pacific Railroad has purchased from the St. Paul, Minneapolis & Manitoba Railroad the latter's line along the east bank of the Mississippi River, between Wattab and Anoka. The Northern Pacific will now bridge the Mississippi at Anoka, and from that point extend the purchased line into Minneapolis. These changes assure the Northern Pacific a continuous line from Minneapolis to Brainard.

Another Line to St. Paul, Minn.—Des Moines, Ia., June 2.—The work of broadening the track of the narrow-gauge extension of the Chicago & Northwestern extension from Ames to Jewell Junction is completed. This opens up through standard-gauge track from this city to St. Paul via the Chicago & Northwestern. It is expected regular trains will be put between these two points next week. The Northwestern now owns no narrow-gauge track in Iowa.

Work Abandoned.—Galveston, Tex., June 3.—The *Houston Post* says: "The work of construction on the New York, Texas & Mexican road will be abandoned upon completion of the road to Victoria, which point will be reached about June 17. The inability of the State to make desirable land grants is given as a reason for this decision."

The Scioto Valley and Chesapeake & Ohio's Proposed Extension.—Bellefontaine, O., June 1.—Colonel Fisher, of Columbus, with a corps of twelve assistants, has been engaged the past week in surveying a route from Columbus to Fort Wayne for the Scioto Valley Railroad Company.

On to Omaha.—Atchison, Kan., June 2.—The new Missouri Pacific extension from Atchison to Omaha is finished, the last rail having been laid yesterday afternoon at 3:30 o'clock at a point three miles north of Huron, in Atchison County.

The Broadway Underground Road.—A bond of $100,000 as a guarantee for the completion of the Broadway Underground Railroad was filed in the Comptroller's office on the 2d. The bond will be forfeited if the road is not completed within five years from July 1 last.

A New Minnesota Line.—Articles of association for the St. Paul, Minneapolis & Sea Coast Railroad have been filed. Officers have been elected as follows: Alexander Ramsey, St. Paul, president; Judge Thayer, Clinton, Iowa, vice-president; H. H. Sibley, St. Paul, treasurer. Capital, $3,000,000. The object of the association is to build a line of railway from St. Paul and Minneapolis to eastern and southern connections at Clinton, Iowa, and to tap the coal mines in that section. Preliminary surveys have been made, and the distance is 290 miles as the line is laid out on paper.

Nebraska Railroads.—The State Board of Equalization reports the total number of miles of railroad in Nebraska at 2,286; total assessed valuation, $14,668,950, an increase over last year of $2,000,000. The Union Pacific and other Gould lines have 897 miles in Nebraska, valued at $3,732,317. The Burlington road and leased lines amount to 914 miles, assessed at $6,010,840.

Incorporated at Albany, N. Y.—The Tunnel Extension Company. The road is to run in Atlantic avenue, Brooklyn, about 2,000 feet. Capital, $50,000.

Southern Minnesota Line.—The Milwaukee & St. Paul Company has placed seven large construction gangs, fitted out with steam plows and other grading implements, along the entire length of its Southern Minnesota route. This track is to be entirely relaid, and all the bridges are to be reconstructed or replaced.

The Newton Circuit Railroad.—From the Boston *Journal* of the 2d we learn that on the previous day the directors of the Newton Circuit Railroad filed with the Railroad Commissioners a report made to them by G. R. Hardy, engineer of the Boston & Albany Railroad, relative to the surveys of the road and an estimate of the cost of construction. The proposed route runs from Brookline to Newton Highlands on the southerly side of the Woonsocket division of the New York & New England Railroad, and generally immediately adjacent thereto. The estimated expense is tabulated as follows: Section A, $405,002; Section B, $178,655; total, $582,657.

Unless the negotiations are soon successful that are now pending between the New York & New England Company and the Boston & Albany relative to the purchase of that part of the Woonsocket Branch of the former road between Brookline and Newton Highlands, active work in constructing this line will be commenced. Locations are to be asked for of the Newton and Brookline authorities next Monday.

To be Extended.—New Richmond, O., June 2.—Superintendent Walker and General Agent Henley are here arranging for the immediate extension of the Ohio River Branch of the Cincinnati and Eastern Railroad to Moscow, eight miles east of New Richmond.

Milwaukee and Lake Winnebago.—The Milwaukee and Lake Winnebago officials have now definitely decided to build from Oshkosh to Neenah. The route between Oshkosh and Neenah will be directly beside the Northwestern track, the west-line fence of the Northwest right of way being the east-line fence of the Milwaukee and Winnebago route.

Missouri Railroad Extension.—Hiawatha, Kan., June 1.—The last rail of the Missouri Pacific Extension was laid at Everest, in this county, to-day. A passenger train of railroad men from Atchison will visit Hiawatha to-morrow, and be entertained by our city authorities.

The Baldwin Locomotive Works are building thirty locomotives for the Reading Railroad.

The Savannah & Pacific Short Line Railroad Co. has been organized to build a line from Savannah to Columbus, Ga., about 250 miles. Capital $3,000,000. Directors, W. W. Wright, Phinehas Prouty, Alexander L. Chew, Joseph S. Lewis, all of Geneva, New York; and F. E. Burk, of Americus, Sumter County, Georgia.

Railway Property in Louisiana.—From a statement read by Mr. Wheelock, representing the New Orleans Pacific Railway Company, before the Louisiana Legislative Committee on Railroads, at Baton Rouge, on May 31, we take following items: "Of railways which are completed, I may mention the Louisville & Nashville, formerly the New Orleans & Mobile; the Jackson road, the Morgan road, the Louisiana Western—in all comprising 530 miles of railway in the State of Louisiana. The following roads are in process of construction: The New Orleans Pacific, from New Orleans to Shreveport, 325 miles, running through the parishes of Jefferson, St. Charles, St. James, St. John, Ascension, Iberville, West Baton Rouge, Pointe Coupee, St. Landry, Avoyelles, Rapides, Natchitoches, De Soto, Sabine and Caddo. The Arkansas Branch of the New Orleans Pacific, from Alexandria to Knobel, Arkansas, 125 miles in Louisiana, running through the parishes of Rapides, Grant, Catahoula, Caldwell, Ouachita and Morehouse. The Vicksburg, Shreveport & Texas, 200 miles, running through the parishes of Madison, Richland, Ouachita, Jackson, Bienville, Webster, Bossier and Caddo. Northeastern, from New Orleans to Meridian, in Louisiana 50 miles, running through the parishes of Orleans and St. Tammany. Natchez, Red River & Texas, from Vidalia to the Sabine River, 180 miles, running through the parishes of Concordia, Catahoula and Rapides. New Orleans & Mississippi Valley, from New Orleans to Memphis, on the east bank of the Mississippi River, 130 miles in Louisiana, running through the parishes of Orleans, Jefferson, St. Charles, St. John, Assumption, East Baton Rouge, East Feliciana and West Feliciana. Mississippi Valley, from Vidalia to Arkansas City, 102 miles in Louisiana, running through the parishes of Concordia, Tensas, Madison and Carroll. Southern Pacific, known as the Huntington road, from Vermilionville to New Orleans, 130 miles, running through the parishes of Lafayette, St. Martin and Iberville. Showing nearly 1,100 miles of railway projected by responsible parties.

Railroad property in Georgia increased two and a quarter million dollars in value last year.

A Big Salary.—The trunk-line presidents have advanced Pool Commissioner Fink's salary to $30,000 per year.

A Street railway is to be built at Columbus, Miss.

Railroad Building in the United States.—The *Railway Age* says the impression prevails that the building of railroads has fallen off this year from the enormous total of last year, which was between nine thousand and ten thousand miles. The fact is that during the first five months of 1882 there have been built on one hundred and twenty lines of railroad 3,480 miles of track. Considering that only 1,500 miles had been built at this time last year and that building increases rapidly the latter half of the year it would be a logical conclusion that the total of this year's building operations would be 23,000 miles, but, of course, this figure will not be reached. There are at least three hundred and fifty lines, covering, at a moderate estimate, a total of 25,000 miles, upon which work is either now in progress or is proposed to be commenced during the present year.

[Comparatively few new railroads are being projected this year and it is probable that the mileage of construction will be less this year than it was last.—Editor Engineering News].

Work Commenced.—Construction has been begun on a projected road between Vera Cruz and the Pacific Ocean.

CANALS.

The Louisville Water Power and Improvement Company.—Hon. Proctor Knott, President, and Col. S. Taylor, Superintendent, of this company, have been on an extended tour through New England to examine into the utilization of water power in that industrious section of the country.

Promoters of the Hennepin Canal bill will endeavor to have it inserted in the River and Harbor bill.

CONTRACTS LET.

Pike Contracts Let.—Proposals for the grading, graveling, stonework, culverts and bridges of certain pikes were received by Samuel Craig, C. E., at Wapakoneta, Ohio, on May 31. The following awards have been made: Elliott Pike sold to A. F. Rinehart, of Uniopolis, Ohio, for $6,931. Barth Pike sold to William Barth, of New Bremen, O., for $9,750. Amsterdam Pike sold to Lewis F. Wellman, of New Bremen, O., for $1,650. Cumberland Pike sold to Reed, Berry & Martin, of Versailles, O., for $5,880. Geyer Pike sold to Wilson L. Bailey, De Loss P. O., Auglaize County, Ohio, for $8,900.

Paving Contract Let.—The contract for paving Congress avenue, New Haven, Conn., from Cedar street to Bond street, with Telford pavement has been awarded to Messrs. C. W. Blakeslee & Son. A portion of Brewery street is soon to be paved with Belgian blocks.

Contracts for Construction.—Norwalk, O., June 1.—Contracts for the construction of the Wheeling & Lake Erie shops here have been let to D. K. Creamer & Co., of Toledo, for $20,000, exclusive of foundations, which are to be done by the yard. Work will begin at once, and will be pushed with all possible rapidity.

Street Contracts Let in St. Paul, Minn.—The Board of Public Works has let the contract for grading Tenth street from Lafayette avenue to Jackson street to Simar & Morton at $9,850, and that for constructing a sewer on Third street was given to A. J. Cooper for $2,497. The award of contracts for paving Seventh street from Jackson to Kittson was laid over. The lowest bid was that of L. H. Patchen, $22,895.

BUILDINGS.

Public Buildings.—The Senate has passed bills authorizing the construction of four new public buildings; one at Concord, N. H., at a cost of $200,000; one at Pensacola, Fla., at a cost of $200,000; one at Marquette, Mich., at a cost of $100,000, and one at Brooklyn, N. Y., at a cost of $800,000.

New Hotel.—Nineteen thousand dollars has been subscribed towards building a new hotel in Georgetown, Ky.

The Southern Pacific shops, to be located in Houston, Tex., are to cover an area of 1,800x1,200 ft., and include the following departments: A round-house with 44 stalls to accommodate 44 locomotives; an office, 30x60; oil-house, 25x50; store-room, 30x100; machine shop, 100x300; transfer table and pit, 50x348; foundry, 70x240, with two cupolas; brass foundry, 25x60; engine room, 30x50; paint shop, 70x200; iron-house, 30x30; blacksmith shop, 80x165; boiler shop, 80x75; car-shop, 100x300, with coal bins, large water tanks, etc., equal to the supply of this vast enterprise.

The corner-stone of the new $3,000,000 Produce Exchange to be built in this city was laid on the 6th, with the usual interesting ceremonies of such occasions.

Passenger Depot.—The Detroit *Free Press* says: "It has been definitely decided that a new passenger depot shall be built in this city for the Michigan Central Railroad Company upon the site of the present structure. The new depot will cost $140,000 to $150,000, but work will not be commenced until after Mr. Vanderbilt returns from New York and approves the plans, which will probably postpone active operations until the last part of June, certainly till after the 15th." When will Mr. Vanderbilt join with the other road on the Lake front and put up a first-class depot to take the place of that dismal litte trap at the foot of Lake street!

Society Building.—A fine building is soon to be erected by the Sigma Phi Society of Williams College, at a cost of $50,000.

New Hotel, This City.—Plans have been filed in the Bureau of Buildings by Robert and Ogden Goelet for a new and extensive hotel, which they intend to build on the northest corner of Broadway and Forty-third street.

Expensive Villa.—A contract has been signed for building a $50,000 villa at Ochre Point, R. I., for Prof. Charles W. Shield, of Princeton College.

New Orleans is experiencing a building boom, over $2,500,000 having so far been invested in new buildings the present season.

The new depot at Atchison, Kan., will be begun soon.

LABOR.

A Neat Bonus.—Winston Brothers, the contractors on the Chippewa Falls & Northern road, offered their employés $1,000 if they would complete the grade between Chippewa Falls and Bloomer by June 1. The grade was completed, and the men therefore secured the bonus.

Cutting Down Forces.—A general reduction of forces is taking place all over the country. But a few months ago the people were ready to condemn the Iron Mountain management for reducing forces. In regard to cutting down of forces the Cincinnati *Enquirer* says that the Wabash has cut off every employé that could be spared, and in Indianapolis even went so far as to order the telephone out of their local office. On the Pennsylvania Company's lines west of Pittsburgh, within the past thirty days 3,500 men have been discharged, 1,000 of whom were on the Pittsburgh, Cincinnati & St. Louis alone. Extra trains have been taken off the lines, and every leak has been stopped. This week six train gangs were taken off the Indianapolis & St. Louis road, and the yard force on all lines has been reduced. Other precautionary measures against a shortage in earnings have been taken, all indicating an unusually dull business and consequent light receipts.

Large Pay-roll.—When the Pennsylvania Railroad shops in Altoona are in full operation they employ 3,500 men, and the pay-roll reaches $170,000 per month. The estimated value of the Pennsylvania shops at that point is $30,000,000.

Wages in Boston.—The Aldermen of Boston have concurred in an order authorizing a 5-per-cent. increase in laborers' wages, provided that the sum be not less than $1.80 a day or greater than $2.10.

BRIDGES.

The Keystone Bridge Co. is putting up a new bridge over the Monongahela River, at Brownsville, Pa., for the Pennsylvania R. R. Co.

The Forth Bridge.—The bill for the construction of the Forth Bridge has been passed by a Select Committee of the House of Commons. It is estimated that 43,000 tons of steel will be used in its construction, and that it will cost £1,750,000.

A Minneapolis Bridge.—The three iron spans for the new Plymouth avenue bridge are now in place, and the structure is accommodating the travel in that portion of the city. The employés of the Canton Bridge Company are also attaching the sidewalk to the completed spans.

A Virginia Bridge Repaired.—Mayo's Bridge, over the James, at Richmond, is being thoroughly overhauled and repaired.

Bridge to be Built.—The fine bridge at Emerson, carried away by the floods on the Red River, is to be replaced by an iron structure to cost $45,000, of which the Dominion government gives $30,000, the city of Emerson $10,000, and Manitoba $5,000.

Railroad Bridge.—Washington, June 1.—The bill passed authorizing the construction of a railroad bridge across the Sault Ste. Marie River, between Lake Superior and Lake Huron, with the purpose of connecting with the Canadian railroads.

A New Jersey Bridge Finished.—The cars crossed the bridge to Sea Isle City for the first time on June 2.

New Massachusetts Bridge.—The selectmen of Amherst have ordered of the Corrugated Iron Company of New Britain, Ct., an iron bridge to take the place of the wooden one across Freshmen River at Mill Valley, and expect to have it in position by August.

New Iron Bridge.—A joint committee representing the city and town of New Haven, Conn., have authorized the City Engineer to make the necessary surveys, and to prepare plans and estimates, for a new iron bridge to replace the old structure known as Tomlinson's bridge. The location of the bridge is at the head of the harbor, where it is joined by the Quinnipiac River, and near the wharves of the New York & New Haven Steamboat Company. The proposed bridge will be about 400 ft. in length, and will probably consist of two fixed spans of about 125 ft. each, and a pivot span of about 150 ft.

The Pittsburgh Bridge Company have orders for twenty new bridges and work enough ahead to employ their men for four months, day and night.

CONTRACTS.

Lt. Col. Thos. Lincoln Casey, U. S. Engineer, Washington, D. C., will receive proposals for an hydraulic elevator till June 20.

MISCELLANEOUS.

The Largest Issue.—The Patent Office on the 6th issued 412 regular patents, 11 designs, 6 reissues, 15 certificates of registration, and 7 certificates of registration of labels. The receipts from the above source were $15,002. This is the largest weekly issue ever made by the office.

Incorporated.—The Northwestern Iron Company of Duluth, Minn., filed articles of incorporation with the secretary of State. The capital of the company is $20,000 divided into 800 shares of $25 each. The incorporators are F. S. Farr, Lars Nelson and R. S. Rost of Muskegon, Mich., and Joshua Evarts of Duluth.

The tunnel under the Boston Mountains, Mo., will be completed by July 1.

Durango Iron Mountain.—The wonderful mountain of iron ore two miles northwest of Durango, Mexico, has been purchased by a California firm for $150,000. Twelve months ago the mountain could have been bought for $20,000. So says the *Age of Steel*.

The bath-house committee of the city of New Haven, Conn., have decided to have an additional floating bath-house, and have located it on Mill River at the foot of Beech street. The plans are now being prepared at the office of the City Engineer.

THE WEEHAWKEN TUNNEL.

The New York, West Shore & Buffalo Railway commences at Weehawken, New Jersey, passes through the hills, turning to the north, keeping along the line of the Hudson River, striking Haverstraw, West Point, Newburgh, Kingston, and at Coeymans Junction, dividing, the mein line going to Buffalo, and the branch to Albany. The hills upon the west side of the Hudson commence in a small ridge opposite New York bay and extend in a northerly direction along the bank of the river and at varying distances from it. All the railroad lines reaching New York City through New Jersey have found a formidable barrier in this ridge, and when the height prevented an open cut, have been obliged to resort to tunneling.

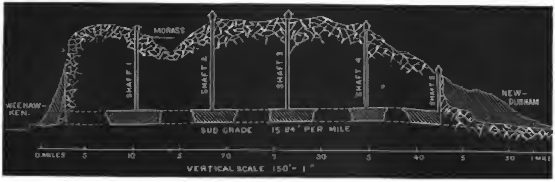

FIG. 1.—PROFILE SHOWING COMPLETED SECTIONS.

During the early part of this week we visited the tunnel at Weehawken, now being built by the above-mentioned company, under contract with Messrs. Smith, Ripley & Coleman, and under the guidance of the Superintendent, Mr. J. P. Stanton, thoroughly inspected the work. Extensive dock facilities, designed for the accommodation of both passenger and freight traffic, are now being constructed at the river end. There will be twelve piers of ample size to permit of the easy handling of freight, separated one from the other by deep water slips. Tracks lead from the tunnel to each of the piers. South of these is the passenger station and ferry, one line from which will land at the foot of Forty-second street, and another line will go down town to a point not yet determined. Just south of the station a round-house will be located. Such additional tracks and shops as may be necessary will be placed on the meadows at the New Durham end of the tunnel.

The profile (Fig. 1) shows the contour of the hill and the positions of the portals and of the shafts. Work was begun just fifteen months ago and five shafts have been sunk from the top of the hill to the grade line of the tunnel. From the foot of these shafts work has been pushed in both directions, with the exception of No. 5, in which, owing to its location, progress is only made in an easterly course.

These shafts were sunk the following depths:

No. 1 east portal	140 ft.
" 2	165 "
" 3	180 "
" 4	140 "
" 5	88 "

The cross-section measurements are 8 by 16 ft.

Descending shaft No. 1, we visited the eastern heading to examine the method of excavating. Five Rand drills were at work rapidly opening a receptacle for a dose of high explosive, whose pent-up forces were to be liberated by the agency of electricity. All the men leave the tunnel when a charge is to be exploded, returning after things have quieted down. The loose material is placed upon cars running upon two tracks, which are laid as rapidly as the heading advances, and pushed to the bottom of the shaft. The hoisting machinery consists of a Copeland and Bacon engine located in a little shed at the mouth. Two wire cables extend from the drum of the engine to two platforms, so placed in regard to the ropes that one is descending while the other is ascending. The loaded car is run upon one of these, raised to the surface, where it is taken by a locomotive to the place assigned for its load. To relieve the work of water a Worthington pump is placed at the foot of each shaft and is supplied with steam by the boilers at the mouth.

Air for the drills is furnished by five Rand compressors placed at the eastern side of the work.

No support will be required for the roof of the tunnel for about three-quarters of its length: the remaining portion will be supported by brick masonry two feet thick and set in Portland cement. From the base to the beginning of the arch excavated rock will be used. The method of bracing is clearly shown in Fig. 2, when the loose material is held back by beams of wood. When a sufficiently firm resting place cannot be found at the spring points of the arch vertical pieces are added which are supported from the bottom. These timbers are 12 by 14 in., and so placed as to admit of the brick-work without their removal, as indicated in the drawing. When deemed essential additional security is obtained by running other timbers above those already mentioned, but in a longitudinal direction.

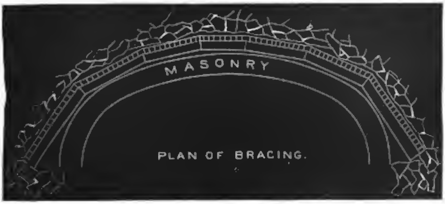

FIG. 2.

The tunnel is 27 ft. wide, 21 ft. high—or 19 from the top of the rails to the center of the arch—and the roof semi-elliptical. Fig. 3 presents a cross-section with a maximum engine and car. The distance between the centers of the track will

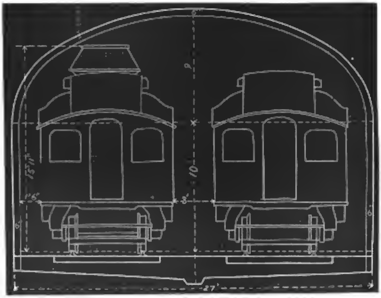

FIG. 3.—CROSS SECTION OF TUNNEL.

be 13 ft., the clearance between cars 3 ft., and between the side of the cars and the wall 1 ft. 6 in.

Rapid progress has been made since the commencement of the operations just fifteen months ago, the amount now finished being shown in the shaded portions of the profile drawing Fig. 1. The rate during May in the east heading of shaft No. 1 was 66.5 ft.; timbering delayed operations in the other heading. The combined progress of both headings in shaft No. 2, was 65 ft.; shaft No. 3, 100 ft.; No. 4, 96 ft., and in No. 5, 66 ft., making a total for the month of 393 ft. The total amount now finished is 2,429 ft., and there remains to be done 1,571, making a total length of 4,000 ft. The amounts finished at each shaft are as follows:

From east portal to shaft 1	460 ft.
" shaft 1 to shaft 2	331 "
" " 2 " " 3	315 "
" " 3 " " 4	326 "
" " 4 " " 5	149 "
Total of	1.571 "

Extending from the eastern to the western portal on the summit of the hill is a railroad, crossing the morass shown in the profile by means of a trestle, with side tracks at each shaft. Near the western extremity are three Blake crushers. The crushed rock is thrown over the western side and will be used as ballast when needed.

At the western approach we found two steam excavators at work—one upon each track. The rock is loosened immediately in advance of the machine by blasting, when it is lifted and dumped into cars, which are hauled by a locomotive to the dumping ground.

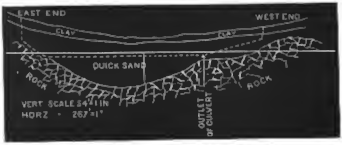

FIG. 4.—LONGITUDINAL VIEW OF BASIN.

A short distance from the western portal the rock suddenly dips, forming a basin, as shown in Fig. 4. This was filled with sand covered with a layer of clay. Much trouble has been experienced from the water, and a trench two feet by two feet six inches has been built to carry the surplus away. This relieved the work to a certain extent, but as the water still gave much trouble while excavating a system of piling was adopted, as shown in Fig. 5. As the water flowed from north to south through the depression it was proposed to sink two systems of short piling seven feet apart about half filled with stone, as shown in the illustration. The filling has been omitted and only the piling driven. This plan is being carried out on the north side of the cut and has resulted in an almost perfect exclusion of the water from the work.

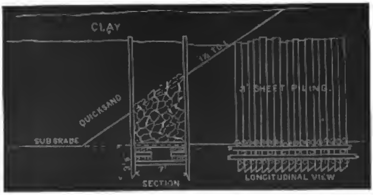

FIG. 5.—SYSTEM OF PILING TO PREVENT IFNLOW OF WATER.

The approach cut to the western extremity will be 2,700 ft. long, and is being rapidly pushed toward completion.

The approximate quantities excavated and to be excavated are: In the tunnel, 80,000 cubic yards; in shafts 3,000 yards, and in the approaches, 180,000 yards.

In order to avoid sharp curves the mouth of the eastern portal will be trumpet-shaped, the enlargement beginning about 100 ft. back. The increase will be to 50 in. width, and a proportional height.

The force consists of an average of 450 men in the tunnel, working in two shifts of twelve hours each. The number on the approach is 200. The plant consists of 5 Rand compressors, about 50 Rand drills (in operation day and night), 4 locomotives (2 at the western approach, 1 on top and 1 at the east end), 2 steam excavators, 3 Blake crushers and boilers, hoisting engines and electric light apparatus at each shaft.

APPLIED ELECTRICITY.

Prof. A. Graham Bell, the inventor of the telephone, for which invention he received a gold medal at the recent Paris Exhibition, and also the ribbon of the Legion of Honor, returned from Europe on the Servia on the 12th. He expressed himself much pleased with what he had seen at the exhibition, the most important features of which were the electric lights and the transmitted power machines. He said: "The display of electric light was very fine indeed. The electric motors and the railways were extraordinary. I think that the use of electricity to transmit power is going to bring about a revolution in mechanical appliances. The power transmitted is not less than 50 per cent. of that applied to the dynamo-electric generators, and as a method of utilizing power at a distance it is undoubtedly the best that has yet been discovered. Water-falls, the tides, any natural source of power, for example, may be used to work the dynamos, and the electricity may be taken almost any distance."

He considers the electric railway quite practical. He says: "I rode in that of Siemens, and I examined all of them carefully. They get rid of the locomotives entirely, because the power is applied directly to the axles of the cars. The Siemens road has a wire running alongside of the track upon which a traveling pulley is carried. With elevated roads, however, it would not be difficult to insulate the two rails and make them the conductors for the electricity. This could also be done on surface roads, but there would always be the difficulty that any conductor lying across the track would deprive the train of its supply of electricity. The dynamo motors I saw were all of the same general type. They all had moving armatures actuated by interrupted currents and reversed poles. Opposite to these were fixed electro magnates excited by induced currents. They worked very well and were easily managed."

Of Faure's batteries he saw "a very large number. They are really Gaston Planté's batteries and he should receive the credit for them. Faure modified the Planté battery and the apparatus exhibited by him should be called Faure's modification rather than Faure's battery, as it is generally termed. Planté's battery consisted of the lead plates with the nimium deposited upon them by electricity! Faure's modification was the mechanical instead of the electrical coating of the lead with nimium. The result of his modification has been to make the battery more instantly effective than it was before. While Faure has made a most important improvement, I do not think that the credit of the invention should be taken from Planté."

"Do you think the invention of these secondary batteries is an important one.

"Unquestionably. I think that it will solve the problem of the domestic use of electricity for purposes of illumination and as a source of power. If each house can have in it a store of electricity such as one of these batteries furnishes, the lights and power wanted can be supplied and the battery can be resupplied say once a day. This will make the supply constant and much more to be depended upon than the system of tapping the wires. It makes the source of the electricity used in a house individual and completely under the control of the householder. This I regard as an important prerequisite to any general use of electricity in houses. By the way, Planté received a gold medal from the exhibition, while Faure got one of lower grade."

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES. M. AM. SOC. C. E.

(Continued from page 189.)

CCCXXVIII.—WINONA.

Winona, Minnesota, in lat. 44° 2' N., long. 91° 40' W., on the Mississippi River, is on a plateau 12 to 15 ft. above the river, and surrounded by bluffs. Settled in 1851, it was incorporated as a city in 1857.

Water-works were built in 1876 by the city, after plans by J. B. Fellows and J. J. Randall. The supply is taken from two wells of 10 ft. and 16 ft. diameter, near the river bank. These wells are about a mile apart. From one of them the water is pumped by a Blake pump, and from the other by a Knowles pump, each in a mill, and the pumping is done by contract. The water is pumped directly into the mains under an ordinary pressure of 60 lbs. For fire service the pressure can be increased to 180 lbs., the limit of a safety valve on the main. The use of direct pumping is not considered satisfactory, and a stand-pipe 210 ft. high and 4 ft. in diameter is now in course of construction, and two pumping engines, one of 2,000,000 gallons capacity, with a compound condensing engine, and one of 3,000,000 gallons, with a compound duplex high-pressure engine. Distribution is by cast-iron pipe of from 16 to 4-in. diameter, of which 8 miles are in use, with 90 fire hydrants, 31 gates and 300 taps. For service pipes both plain and galvanized iron are used.

The population in 1880 was 10,208, and the daily consumption about 400,000 gallons.

The works have cost $100,000. The additions now in progress will cost $60,000. The bonded debt is $40,000, bearing 7 per cent. interest. The expenses in 1881 were $6,500, and the receipts $1,900.

The works are managed by a special committee of the Common Council.

A. W. Gage is the chairman of the Water Committee.

CCCXXIX.—OWENSBORO.

Owensboro, Kentucky, in lat. 37° 47' N., long. 87° 8' W., is on the Ohio River.

Settled in 1816, it was incorporated as a city in 1866. Water-works were built by a private company in 1879, taking the supply from the Ohio River and pumping directly into the mains by two Holly steam pumps with steam cylinders of 35-in. and pumps of 14-in. diameter and 28-in. stroke. The ordinary pressure is 40 lbs. and the fire pressure 100 to 140 lbs.

Distribution is by cast-iron pipe of from 10 to 4-in. diameter, of which 8 miles are laid with 76 fire hydrants, 25 gates and 400 taps. The city pays $50 per year for each hydrant. For service pipes, lead and galvanized iron are used.

The population in 1880 was 10,000 and the daily consumption 250,000 gallons.

The capital stock of the company is $80,000.

There is a bonded debt of $100,000, at 6 per cent.

The receipts in 1881 were $14,000 No further financial statistics are given.

H. P. Martin is the Superintendent, H. H.

Hodgson the Secretary and Treasurer and Samuel A. Muller the General Manager.

CCCXXX—MADISON, IND.

Madison, Indiana, in lat. 38° 46 N., long. 86° 23 W., is on the Ohio River.

It was incorporated as a town in 1825 and as a city in 1838.

Water-works were built by the city in 1849, after the plans of Thomas J. Godman and under the direction of Theodore R. Scowden, C. E.

The supply is taken partly from springs and surface water, impounded by a dam across a ravine, the reservoir holding 6,000,000 gallons, and partly from the Ohio River. The water is pumped by a plunger pump of 9½ in. in diameter and 72-in. stroke, into two reservoirs 212 ft. above the river, one of them being 80 ft. in diameter and 20 ft. deep, and the other 73 ft. in diameter and 16 ft. deep.

Distribution is by cast-iron pipe of from 12 to 4-in. diameter, of which 8 miles are in use, with 106 fire hydrants, 100 gates and 600 taps. Service pipes are of wrought iron. The population in 1880 was 9,009. The daily consumption is 400,000 gallons

The works have cost $100,000, which is the amount of the bonded debt at 8 per cent. interest.

The receipts in 1881 were $6,000 and the expenses of maintenance $5,000.

The works are managed by three Trustees elected by popular vote.

Charles E. Godman is the Superintendent and A. C. Pague the Secretary.

CCCXXXI.—ASHLAND, PA.

Ashland, Pennsylvania, in lat. 40° 48 N., long. 76° 18 W., is on Mahanoy Creek, in a mountainous region.

Settled in 1848, it was incorporated as a borough in 1857.

Water-works were built in 1876 by the borough, after plans of Isaac S. Cassin, C. E., taking the supply from Little Mahanoy Creek, a mountain stream which has its source on Broad Mountain, 1,400 ft. above the sea. A stone dam backed with clay, built across the stream 5 miles from the town and 345 ft. above it, forms a reservoir, from which the water is conveyed to the town in a 12-in. cast-iron pipe, 27,400 ft. long, and is distributed by 3 miles of cast-iron pipe of 8 to 3-in. diameter, with 30 fire hydrants, 34 gates and 450 taps.

Service pipes of lead and of wrought iron are used.

The population in 1880 was 6,014. The consumption is not known.

The works have cost $68,100, and the total receipts have been $10,483.07. The bonded debt is $53,000, at 6 and 4 per cent. interest.

The expenses in 1881 were $1,589.99, and the receipts $3,840.

The works are managed by three Commissioners elected by the borough Council.

Fred. Rodrian is the Superintendent.

CCCXXXII.—WOOSTER.

Wooster, Ohio, in lat. 40° 46′ N., long. 82° 56′ W. in a hilly country with numerous valleys and streams, is what is called the "second bottom" lands between Killbuck and Apple creeks. There is a difference of level in two miles over which the city extends, of 290 ft.

Settled in 1809, it was incorporated as a village in 1817 and as a city in 1869.

Water-works were built by the city in 1869 after the plans of Emil Low, C. E., taking the supply from springs yielding 60,000 gallons per day, and the drainage of a water-shed of about 1½ square miles. A dam of puddled earth 300 ft. long and 20 ft. high impounds the water in a reservoir of 1½ acres, averaging 10 ft. deep, and 130 ft. above the lower part of the city.

The supply is insufficient and the quality of the water in summer is bad. An additional supply, by pumping from a stream which passes through the lower part of the town, is in contemplation.

Distribution is by 8½ miles of cast-iron pipe of from 12 to 4-in. diameter, with 88 fire hydrants, 30 gates and 220 taps.

Service pipes are of galvanized iron.

The population in 1880 was 5,933, and the daily consumption 200,000 gallons.

The works have cost $85,000. There is a bonded debt of $50,000 at 7 per cent. interest.

The expenses in 1881 were $400 and the receipts $1,300.

The works are managed by three Trustees. O. G. Coover is the Secretary, and M. M. Smith the Superintendent.

CCCXXXIII.—ROCHELLE.

Rochelle, Illinois, in lat. 41° 55′ N., long. 89° 18′ W., is on the Kaite River in a rolling country. Water-works were built in 1877 by the city, after plans by George C. Morgan, taking the supply from springs in an old quarry yielding about 300,000 gallons per day. The reservoir holds about 12,000,000 gallons. The water is pumped directly into the mains by two Worthington duplex engines, the second one erected in 1880. The ordinary pressure is 40 lbs. and the fire pressure 100 lbs.

Distribution is by two miles of 8-in. and 6-in. cast-iron pipe, with 24 fire-hydrants, 4 gates and 40 taps. Service pipes are of wrought iron.

The population in 1880 was 1,896. The consumption is not given.

The works have cost $19,000. The bonded debt is $5,000, at 7 per cent. interest. No further financial statements are given.

The works are managed by a committee of the Council. G. F. Northrop is Chairman.

CCCXXXIV.—TUNKHANNOCK.

Tunkhannock, Pennsylvania, in lat 41° 32′ N., long 75° 57 W., is in a valley two miles long and one mile wide, surrounded by hills, and on the Susquehanna River, at the mouth of Tunkhannock Creek. There is about 40 ft. difference of elevation in the town. Settled in 1789, it was incorporated as a borough in 1844.

Water-works were built by a private company a number of years ago, taking the supply from springs and conducting it through the town by bored logs. The date of construction of these works has not been furnished. In 1870 the works were reconstructed after plans of Harvey Sickler. The water is taken from four springs about 1¼ miles from the town, supplemented in dry seasons by a small mountain stream draining about ½ square mile and fed by springs. The water of this stream is collected in a small box reservoir 150 ft. above the town. Distribution is by four miles of cast-iron pipe, of from 8 to 3 in. diameter, with 10 fire hydrants, 9 gates and 150 taps. The town paid for putting in the hydrants and pays $5 per year for each one. Service pipes are of wrought iron, lap-welded.

The population supplied is 1,500. The daily consumption is not known.

The capital stock of the company is $20,000.

The works have cost $15,000 and the receipts have been $10,000. There is no debt.

The expenses in 1881 were $300 and the receipts $1,400.

In the spring of 1875, after very cold weather, with no snow on the ground, about 5,000 ft. of pipe laid 4 and 5 ft. below the surface froze and burst. Loose, gravelly soil froze deeper than clay. The pipes were relaid from 6 to 12 in. deeper, and covered with coal culm and spent tan bark.

Harvey Sickler is Secretary and Manager of the company.

CCCXXXV.—WARWICK, N. Y.

Warwick, New York, in lat. 41° 15 N., long. 71° 12′ W., is in a hilly and rocky country, on Mistucken Creek. Settled in 1719, it was incorporated as a city in 1867.

Water-works were built by the city in 1872, after plans of Charles Caldwell, taking tha supply from a small stream, about a mile from the city, and 150 ft. above it, impounded by an earth dam. Distribution is by 4 miles of cement-lined wrought-iron pipe, with 27 fire hydrants and 15 gates. The number of taps is not given. Service pipes are of wrought iron.

The population in 1880 was 1,050. The consumption is not known.

The works have cost $30,000. The bonded debt is $11,000, at 5½ per cent. interest.

The expenses are very small, and the receipts in 1880 were $700.

The works are managed by one Water Comissioner. B. F. Vail is the present incumbent.

CCCXXXVI.—HAMILTON, NEV.

Hamilton, Nevada, in lat. 39° 12′ N., long. 115° 39 W., is in mineral-bearing limestone mountains 8,500 ft. above sea level.

Settled in 1867, it was incorporated as a city in 1869 and disincorporated in 1875.

In 1869 water-works were built by the Eberhardt Mining Company after plans of H. W. Von Schmidt, C. E.

The supply is taken from Illapah Springs, three miles east of Hamilton, where the water issues from a fissure in the limestone rock with an average flow of 1,200,000 gallons per day. There is scarcely any rain there and no apparent water-shed. The source is supposed to be in a mountain range 60 miles to the north. At the first pump station, 15 ft. below the spring level, two Cameron steam pumps with steam cylinders 22½ in. and pumps of 10-in. bore and 60-in. stroke, lift the water 500 ft. through a mile of 12-in. riveted wrought-iron pipe with cast-iron hub joints leaded. The pipe is ¼-in. thick for the lower 250 ft., and ⅛-in. above that. It frequently bursts. The second pumping station with two similar pumps then lifts the water 500 ft. more through similar pipe. The working pressure at each station is 217 lbs. and sometimes by irregular action of the pumps runs up to 250 lbs. To relieve the pipe compressed air is forced into 4 air chambers on the line. The water is delivered into a stone reservoir holding 200,000 gallons on the summit of Momomoke Mountain, 500 ft. above Hamilton, and distributed through 14 miles of 3-in. lap-welded wrought-iron tubing of No. 11 gauge, with cast-iron sleeve couplings and lead joints. This pipe has proved too light for the service, was not well coated with asphalte and has rusted through in wet ground. There are 20 fire hydrants, 10 gates, 125 taps and 20 meters. While Hamilton was an incorporated city it paid $1,720 per year for hydrant service. In 1880, after the White Pine mining excitement which created the town had died out, the population was 500 and the daily consumption 10,000 gallons.

From the reservoir a pipe conveys the water two miles across a deep valley and up the side of Treasure Mountain to the reservoir level, where a third pumping station is placed, and the water lifted 700 ft. through 1½ miles of pipe to the summit of Treasure Mountain and Treasure City.

The water pumped now is chiefly used for mining.

The works cost $380,000. No other financial statements are furnished.

Samuel Liddle is the Engineer and Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGEMENTS.—The receipt of statistics, as follows, is acknowledged with thanks: From Harvey Sickler, Secretary and Manager, statistics and water rates of the water-works of Tunkhannock, Pa. From Frank Rentz, Town Clerk, statistics and water rates of the water-works of Ashland, Pa. From B. F. Vail, Water Commissioner, statistics and water rates of the water-works of Warwick, N. Y. From G. F. Northrup, Chairman Fire and Water Committee, statistics and water rates of the water-works of Rochelle, Ill. From H. P. Mastin, Superintendent, statistics and water rates of the water-works of Owensboro, Ky. From A. W. Gage, Chairman Water Committee, statistics and water rates of the water-works of Winona, Minn. From Samuel Liddle, Chief Engineer, statistics of the water-works of Hamilton, Nevada. From M. M. Smith, Superintendent, statistics and water rates of the water-works of Wooster, O. From A. C. Pogue, Secretary, statistics and water rates of the water-works of Madison, Ind.

RAILWAY TIE AND BRIDGE TIMBER CULTIVATION.

A St. Louis paper says:

The preservation of railway ties and bridge timbers from the destructive moisture of the soils and climate of the Southwest has long been a troublesome problem among the railway managers. Several works representing large capitals have been established here for the treatment of wood by the creosote and other processes, which increase its durability, but the treatment is quite expensive. Some railway men have concluded that the ailantus and catalpa will prove to be the cheapest and most durable wood for tie and bridge timbers. One company, whose road extends chiefly over prairie lands, is having a large plantation seeded for these trees in equal proportions. Both the catalpa and ailantus are readily propagated from the seed, and bear seed-pods abundantly. Another company, whose road enters Texas, is arranging to plant several hundred acres of these trees in that State. Even the Iron Mountain Company, who probably own more heavily timbered land than any other in the country, have contracted for the cultivation of a catalpa farm near one of their stations in Missouri. On this road are catalpa ties that were laid nearly fifteen years ago, and are apparently as sound as ever. It is authenticated that in Southern Ohio, where one species of catalpa is indigenous, there are posts and timbers of this wood that have been in ground a full century and yet show no signs of decay. These are hardy trees, and of a very rapid growth. Although the ailantus is an importation from China, still it and the catalpa seem to find in climates and soils of Missouri, Arkansas and Texas just what they require to thrive upon. It is now certain that they will for some years, if not permanently, receive extensive attention from the railway managers of the Southwest.

THEY ARE BLESSINGS.

Half the business men visited by newspaper solicitors and asked for advertisements consider the newspaper men as a kind of infliction of Providence, which must take a certain course before being cured. This is error. The newspaper, instead of being a sort of visitation from the lower world, is a public necessity, and for the public good. Instead of dead-beating its way in the world, it thrives upon money hard-earned, and for which it frequently pays, in one way or another, two hundred cents for a dollar. Business men have made fortunes, have risen from poverty opulence, simply from the benefits of the newspapers across the way. The money the newspapers make is handled by the men who patronize with their business advertisements. Some men say, with a sort of pride, "We never advertise. It's too much like throwing money away." Perhaps so, but the man who advertises extensively has the qualities essential to business success. The advertisements placed in papers are like the kindheartedness of youth, bearing fruit at first and reaching into the years wh en age comes on apace.—*Reading (Pa.) News*

ENGINEERING NEWS

AND

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GEO. H. FROST......EDITOR AND PROPRIETOR.

JULIUS W· ADAMS,* *Past President A. S. C. E.*, } ASSOCIATE EDITORS.
S. D. V. BURR............ }

SATURDAY, JUNE 17, 1882.

EDITORIAL ANNOUNCEMENTS.

***Communications** for Mr Adams should be addressed to Julius W. Adams, care of this journal, New York city. Articles written by Mr. Adams will be signed thus *; and only for articles so signed will he be responsible.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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CORRECTION.—We have received a note from Mr. Dexter Brackett correcting an error we inadvertently made in our article of last week "Concerning Water Meters." The paper to be published in the *Journal of the Engineers' Association* will be a description of experiments with the Deacon waste water meter system.

TUNNEL PROGRESS ON THE N. P. R. R.—The following table shows the progress made in the east face of the Mullen tunnel from the time of the commencement of operations in December last to June 1:

	Linear feet.	Progress per day. Feet
December	22	...
January	117	3.77
February	96	3.43
March	126	4.06
April	135.5	4.52
May	147.5	4.75
Total	644	

Each succeeding month shows a decided increase in the rate of progress, attributable, in a great measure, to more systematic methods of working. The material through which the tunnel passes is granite. Drills run by compressed air are used, and high explosives for the blasting. The total length is 3,850 ft., and, as work is pushed day and night, the present rate of advance will soon pierce the mountain.

RAILROADING IN MEXICO.

The stimulus which has pushed forward the projected railroad lines in Mexico has been different in many respects from that which urged the first Pacific across the continent. The latter was assured of a through traffic from the eastern countries, which would instantly be of sufficient magnitude to pay, and which would be soon followed by increased and more frequent shipments. The Mexican roads will not receive a through trade of remunerative proportions until after a market shall have been established, and until the agricultural and mineral resources shall have been developed. That they are vast, and are only awaiting a judicious application of energy and capital to become financially successful, is well known. Wealth will not be liberally expended in any section when the result cannot be immediately sent to a market demanding such effects. The railroads will accomplish the settlement of the country, the rate of advance depending largely upon the climate, and especially upon the treatment received from the citizens and the government. The aspect of the whole region, especially for the next few years, will be influenced by the class of immigrants who go there, and their object in going. Honesty, perseverance and fearlessness are prerequisites and of much more avail than money.

Reports from all the roads whose lines are back from the shores in the mountainous regions, are most encouraging as regards rapid progress and early completion. The climate is most salubrious, and the trouble experienced by foreigners upon their first arrival almost entirely overcome. Routes along the coast in the low lands are suffering for want of both engineers and laborers, the climatic influences being of such a character as to almost prevent the residence of individuals for a long enough time to become accustomed to them.

Much difficulty has been encountered on the branch of the Mexican Central from Aguascalientes through San Luis to the coast of Tampico. Mexican laborers from Tampico were not a success; gangs from the interior succumbed to the work and the weather. The importation of negroes from New Orleans was a total failure, and we now learn that the road is being built by a force of about 500 Mexicans who have become thoroughly acclimated. We learn from a recently returned engineer, who was engaged on this work, that only from 25 to 30 miles of track have been laid from Tampico, although operations were commenced about one year ago. They are now working in both directions from a point about midway between San Luis and Tampico. The main line has been completed for a distance of 200 miles from the city of Mexico, and is being pushed ahead rapidly, although the engineering difficulties met in the mountains often have a formidable aspect. The financial condition of this portion is good, the local traffic paying well at present, and growing rapidly.

The salaries paid engineers range from $125 (Mexican money) and expenses, for levelmen, up. Laborers get 75 cents per day of ten hours on the branch road, and it is probable that this can be reduced when the line reaches the interior.

◆

THE PANAMA CANAL.

For some time past there has been but little matter—purporting to be information—in regard to the progress being made on the canal. The political side of the question has been freely discussed, yet as our main interest centers not in the scheme but in the practical execution of the scheme, and in the means by which the project is to become a fact, we have had only the most meager items to present.

On May 24 we sent a letter to Messrs. Huerne, Slaven & Company, of San Francisco, requesting information in regard to a contract for certain work on the canal which we understood had been signed to them. Early this week we received a reply headed Nevada City, Cal., and signed by "Slaven Bros., per O. P. Pell, of New York City," to whom our note had been forwarded for his perusal and answer. The letter states: "We have, as you already know, secured a contract to dredge and remove earth (to the depth and width of the proposed Panama Canal) for several miles, commencing at Colon-Aspinwall. Our contract embraces the removal of about 6,000,000 cubic meters of earth, for which we are to receive about $2,000,000. The work will all be done by patented machinery—three 'Hercules Dredging Machines,' requiring but two crews of 7 men each, for each day of 16 working hours, and will complete the whole work inside of 18 months."

It is claimed that this dredge is particularly adapted for work of that character, and in a climate so severe upon the men, and that it will do the "work of one thousand men per hour," or 24,000 cubic yards per day of 16 hours. The machinery for one dredger is nearly completed and ready to ship as soon as the hull of the boat is ready to receive it, and the two other machines are under contract; the estimated cost of the three, delivered at Colon, Aspinwall, is something over $500,000. The writer, in a note, says that "the contract was awarded to Slaven Bros. per Huerne, civil engineer."

From this letter we learn that a contract has actually been entered into for a certain amount of work on the canal. We also learn that no work has yet been done at Colon-Aspinwall, nor will be until the completion of the three dredges. We regret that the writer was not more explicit in regard to the exact character of the work to be done, the distance to be excavated, the disposal of the material, the contract price per cubic meter, the payments on the contract, and many other little items which would be of interest. We would also have liked a description of the Hercules dredger.

◆

TO HARNESS NIAGARA.

Now we have an ambitious company with a far reaching and most comprehensive title announcing its intention to harness the great falls of Niagara, and by the aid of electricity generated therewith furnish light, heat and power to any one who has the requisite moneys to pay therefor and who may reside in any city in North America.

These attacks upon the beauties of Niagara seem to occur periodically, and almost all of them have been pronounced feasible and received the endorsement of eminent men of science. The single exception that we now recall was to that of the citizen of the U. S. A. who was asked while gazing at Vesuvius when in active operation, "If they had anything in America to equal that?" The citizen quietly responded: "No! but we have a water falls that would put that fire out." This scheme failed to receive any encouragement, mainly from the fact that there was a slight difference in the elevations and that the difference occurred on the wrong side.

The project of a chain of mills fed by an immense sluice came to naught, for what reason we do not remember.

That of another enterprising citizen—from the East—who wanted to build a huge water-wheel to turn a shaft extending through the States, and let any body "belt on" who so desired, failed of accomplishment for some unaccountable cause.

Now we have the electric scheme, which is perfectly practicable. The force of gravity acting upon the water would give ample power to generate all the electricity needed; copper wires of the right size would convey the current to any desired point; dynamos would drive the machinery in all the factories. There is no doubt that all the apparatus essential to the success of this scheme could be placed in position. The questions of waste of power at the falls, loss of electricity at each end and during transmission, do not enter into the problem, as the source of all is inexhaustible—even in dry weather there would be more than enough of the tumbling water. Money is all that is wanted; but this is like other ventures, and capitalists are very wary in regard to expenditures.

Should the undertaking prove successful, a few falls in South America, a good sized one in both Africa and Australia, one or two in the Himalayas for Asia, and quite a large one for Europe, and we have the inhabitants of the earth supplied with a servant ready at any time to do their bidding.

WASHINGTON WATER SUPPLY.

The bill before the House of Representatives relative to increasing the water supply of the District has been passed. An amendment provides that the cost of the improvement shall be annually computed and stated by the Treasurer of the United States and charged to an account on the Treasury books, and that the interest shall be annually included in the District tax levy, and paid to the United States Treasurer, and that any surplus of water rents over the running expenses of the works, and the paying of prior interest charges now existing, shall also be paid to the Treasurer and credited to the account thus created until it is paid.

The execution of this bill will afford an ample supply for the residents as well as the government, both for the present and the near future. The entire cost of the works up to the present time has been about $5,000,000, and the daily rate of supply has been, in round numbers 26,000,000 gallons. The expenditure of $1,500,000, in accordance with the provisions of the bill, will increase the supply to 80,000,000 gallons per day. There have been laid 175 miles of mains, exclusive of service pipes, and these are subject to the control of the general government. During the past ten years the annual receipts from water rents have averaged $138,000.

PERSONAL.

CONGRESS has abolished the office of Water Register of the District of Columbia.

J. C. JAMES is chief engineer and superintendent of construction of the Canadian Pacific Railway.

MR. F. C. HAND has been appointed Chief Engineer of the San Pete Valley Railroad, with office at Wales, Utah.

THE English Civil Engineer Douglas is to be knighted for his successful work in the erection of the new Eddystone Lighthouse.

The firm name of **PANCOAST & TARR**, of 28 Platt street, this city, manufacturers of water and gas-works supplies, has been changed to **PANCOAST & ROGERS**.

LIEUT.-COL. THOMAS MCNEISH, a noted contractor, and brave soldier in the late Rebellion under Gen. Rosecrans, died at Nanticoke, Pa., Sunday afternoon, aged 49 years.

MR. C. S. DWIGHT has been re-elected chief engineer of the Chester & Lenoir (N. C.) Railway Company; Mr. James Mason, superintendent and treasurer, and Mr. R. E. Waddill, road-master.

J. G. MACKLIN, for many years chief engineer of the St. Lawrence & Ottawa Railway, has been appointed chief engineer of the entire Midland Railway Combination between Toronto and Ottawa, embracing the different links and railways.

MR. E. S. CHESBROUGH, formerly City Engineer of Boston, now Consulting Board of Public Works, this city, has been paid $1,000 for advice and report on the drainage of the city of Winnipeg, and his services retained for one year at a salary of $3,000 as consulting engineer on drainage and sanitary matters.

MR. VERPLANCK COLVIN, superintendent of the Adirondack survey, has appointed Mr. Fred. Mather, of the United States Fish Commission and *Forest and Stream*, as the naturalist of the survey, with instructions to collect and report upon the fishes of that region. The party will enter the woods at Blue Mountain Lake on the 15th inst.

A. A. ROBINSON, Chief Engineer of the Atchinson, Topeka & Santa Fe Railroad has issued the following order: Mr. F. Leach, Jr., having resigned the position of assistant engineer of the Rio Grande division, Mr. H. L. Marvin is hereby appointed his successor, under the title of resident engineer. All employes of the engineering, track, bridge and building, and water service departments, heretofore reporting to Mr. Leach, will report to and obey orders from Mr. Marvin, whose address will be San Marcial, N. M.

ERASTUS W. SMITH, A. P. D., died at his residence, 42 Dominick street, on the 12th inst. He was a native of Mansfield, Conn., and was well known throughout the country as a consulting engineer. He was the first to receive the degree of Doctor of Physical Arts from the New York University. He had been connected with the Ocean Steam Navigation Company, the Collins line, the New York & Havre Steamship Company, the New York, New Orleans & Havana, the Merchants' Steamship Company, the Norwich & New York Transportation Company, and the North America Steamship Company, either engineer-in-chief, constructing engineer, or superintendent of machinery. He designed and constructed the New Orleans water-works.

JOHN SCOTT RUSSELL, the famous engineer, died in London on the 9th inst.

John Scott Russell, M. A., F. R. S., Vice-President of the Institution of Civil Engineers and the Institution of Naval Architects, eldest son of the Rev. David Russell, was born in the Vale of Clyde in 1808, and received his education at the universities of Edinburgh, St. Andrews and Glasgow, graduating from the latter at the age of 16. He early evinced a liking for practical mechanics, and his father permitted him to take employment in the workshop as an engineer, afterwards assisting him in his studies in cognate sciences. He made such advances in these that on the death of Sir John Leslie in 1832 the young engineer was selected to supply temporarily the Chair of Natural Philosophy in the University of Edinburgh. From this time his career as a practical engineer and shipbuilder became decided. While at Edinburgh he built several small boats for canal and river navigation, and constructed steam carriages for common roads, which ran between Paisley and Glasgow. In London he constructed four large steamships, the Teviot, Tay, Clyda and Tweed, for the West India Royal Mail Company. As a shipbuilder he investigated the laws by which water opposes resistance to the motion of floating bodies, and he established the existence of the "wave of translation" on which he founded his "Wave System." In this science he actually made 20,000 experiments in a few years. The first vessel constructed on his wave principle was the Wava; then followed the Scott Russell, the Flambeau, the Fire King, the Great Britain, and finally the leviathan ship the Great Eastern, so closely connected with the history of Atlantic cables. He was elected Fellow of the Royal Society of London and member of the Institution of Civil Engineers, of which he was Vice-President. He was also a member of the British Association. He was one of the founders of the Institution of Naval Architects, and contributed to it many valuable papers. He compiled a large treatise on "The Modern System of Naval Architecture, for Commerce and War;" also a work entitled "Special Technical Education for the English People." In 1871 he came before the public with his scheme, "The New Social Alliance," by which he aimed at amalgamating political parties and improving the workingman's condition. His writings on the naval transport of railway cars with their freight and passengers received much attention, and the system he proposed has been adopted at many points with success.

GREENE'S Bridge Trusses, 1st Edition, is selling off very rapidly at 60 cents per copy. Postage stamps will be received. When stock on hand is sold the book will be out of print.

JOHN NOLEN, a Philadelphia contractor, put in the only bid that was given for the paving and keeping in repair of the highways, bridges, etc., in the Chestnut Hill district for the present year. The amount was $6,500, which was rejected by the Commissioner of Highways, who, upon readvertising, let the same work upon a single bid for $2,500. Nolen brought suit and has obtained an injunction restraining the Commissioner from awarding the contract. It is claimed for Nolen, that, in the advertisement for proposals the Commissioner failed to reserve the customary right to reject any or all bids, and that, therefore, Nolen being the only and consequently the best bidder is entitled to the contract. We have not learned the decision.

RECENT INVENTIONS.

SUBMARINE VESSEL.

A recent English invention consists of a steam propelled boat for navigating the water below the surface. In its arrangement and construction longitudinal stability rudders are provided, operated by means of a hydraulic engine, whereby the horizontal position of the vessel is preserved. The valves of the vessel are controlled by a swinging pendulum. The vessel is caused to ascend or descend in the water, by the revolution of screw-propellers mounted on the vertical axis at its sides.

TELEPHONE.

Edison's invention for this week consists of an improvement of the telephone; its object being particularly directed toward providing a tension regulator for the vibrating diaphragm in the mouth piece. The whole of the diaphragm is free to vibrate under the action of sound. The tension regulating device is at one side of the diaphragm, and a spring is employed which acts to press the diaphragm toward the tension regulator.

NOVEL PROCESS OF PRODUCING COLORED PICTURES FROM PHOTOGRAPHS.

This improved way of photograph coloring consists of the following successive steps: first, in fixing the paper on which is the picture to a plate of glass, by means of a cement composed of amylum, water, nitrate of strontia, granulated sugar and gum arabic; second, removing almost all the paper fiber by abrasion, leaving only a thin film adhering to the glass; third, coating this film with a hot solution of paraffine and beeswax; fourth, coloring the back of the picture; fifth, excluding air from the same by cementing another glass transparent plate to the back of the first, and retouching the colors on the back of this plate; and, sixth, applying a third plate or board set back of the second plate, and frosted or covered with colored fabric.

DEVICE FOR CLOSING WINDOW SHUTTERS OF LARGE BUILDINGS IN CASE OF FIRE.

This invention relates to a method of rapidly releasing self-closing shutters from the fastenings which hold them open. Its object is to provide for the closing of such shutters, in case of an extensive fire, by means capable of being operated from the outside as well as the inside of the building, so that the shutters can ordinarily be left open for a limited time, thus allowing exterior access to be had to the windows for throwing streams of water in case of fire within the building, and accomplish this object by means of vertical rods or chains supported in position between the windows and capable of being moved longitudinally. These rods are connected with bell-crank levers so arranged with relation to the fastenings by which the shutters are held open that the vertical movements of the rod and consequent oscillation of the bell-crank levers detaches the fastenings from the shutters, and thus releases the shutters to the action of the springs by which they are closed.

ELECTRIC INCANDESCENT LAMP.

A new electric incandescent lamp consists of two electric elastic carbons over-lapping and in loose contact with each other, and inclosed in a transparent or semi-transparent chamber in which a vacuum is maintained.

NEW INSULATING MATERIAL FOR ELECTRICITY.

A Swiss invention treats siccative oil—such as linseed oil—transformed by heat into a solid body. About an equal quantity of resin is added during the transformation. This compound is designed to take the place of silk rubber, and the like in the coating of electric wires to insulate them.

MANUFACTURE OF ICE.

This improvement consists of an ice-house, the walls of which are adjustable double curtains of felt or other heavy fabric to inclose ice frozen by natural cold and protect the ice from warm outside air. The curtain walls are adapted to be lowered from the top to expose water to cold outside air to form more ice.

AUTOMATIC CASH-CARRIER FOR STORES.

Quite a number of recent patents have been issued for devices for doing away with the cash boy in large retail stores. The latest invention of this class provides an inclined way or trough, leading to the cashier's desk from the counters, and a reversely-inclined trough leading back again. Within these ways or troughs travel-rolling spheres or balls contain the money.

GLOBE FOR ELECTRIC LIGHTS.

An important invention has for its object to provide a clear or transparent shade, adapted to soften or reduce the intensity of the light without lessening its illuminating power, thereby obtaining all the advantages of the soft and pleasant light produced by the ground or semi-transparent globe. This globe is formed with a smooth interior surface, but its entire outer surface is formed of small contiguous pyramidal projections; so that each projection is a separate and distinct body to diffuse the light in all directions.

WASHINGTON, D. C. F. B. BROCK.

CORRESPONDENCE.

CALCULATING "OVER-HAUL."

PITTSBURGH, June 12, 1882.

EDITOR ENGINEERING NEWS:

"G. A. M." inquires in your paper of May 25 as to methods of calculating *over-haul*.

So far as I can learn every engineer has his own process, and there is not as there should be an acknowledged method of determination. The following has been my practice: Suppose, for convenience, the price paid is 2c. for every yard hauled 100 ft. after the first 100. Prepare a table of stations and quantities both for excavation and embankment. Then, starting at "grade," determine the station containing the *center of mass* of cut. In the same way find the center of mass of the fill made from the cut. Multiply the distance between the two, *minus the 100 ft.* (hauled free), by the amount hauled. From this subtract the amount obtained in the same way for the quantity next the grade point whose extreme haul is 100 ft. The answer multiplied by 2 gives the cost in cents.

This method though not exact is sufficiently accurate in ordinary cases.

Price of excavation per cubic yard divided by cost of haul per unit of length plus length of free haul = economical limit of *extreme* haul.

The tedious calculations of haul may be done away with by the use of the averaging machine designed by Mr. Auchincloss, mentioned in ENGINEERING NEWS some time ago. ALPHA.

LOCATING CURVES.

RIO GRANDE EXTENSION COMPANY,
SALIDA, Col., June 7, 1882.

EDITOR ENGINEERING NEWS:

Two curves have been run, one to the right and the other to the left, with a tangent 100 ft. long between them, the former being a 20° curve containing 60° and the latter a 12° curve containing 48°.

After completing the above it is found that the latter curve strikes 25 ft. too far right.

How many degrees must be "thrown off" the 20° curve, preserving a tangent 100 ft. long and the 12° curve, to strike the point 25 left of end of 12° curve, or more correctly, a tangent 25' left of first arrived at?

What simple rule would apply to cases of this kind, the object being to preserve the same rates of curvature in both cases and the tangent 100' long? By inserting the above you will oblige

Yours truly, A SUBSCRIBER.

RELOCATION OF RAILROADS.

PORTLAND, Me., June 4, 1882.

EDITOR ENGINEERING NEWS:

Given, A line of railroad, single track, which has been in operation some thirty years, curves originally compounded, but by use and "lining in" somewhat changed from original position, intersection points in most cases inaccessible, and no apparent way of locating points, tangent and curve more definitely than by inspection, original location so defective that but little dependence can be placed upon it as recorded.

Required, To make a relocation of the line as it now is, substantially in accordance with the directions prescribed by the Massachusetts Board of Railroad Comissioners, rule No. 2 of such directions reading: "Said maps shall show the course of the tangents and the radii of the curves of the center line in question; the radius of the land taken, specifying such radius on each side of the center line; also the course of the division lines between the lots over which the location is made, and the distance between them on the curve line. Where but one track is laid, the position of such track with reference to the curve line shall be shown, so that the boundaries of land may hereafter be determined by measurements from the track as laid, if the same shall not have been changed. Where two tracks are laid, it may be presumed that the curve line is midway between them. The course called for above may be either magnetic or true."

Rule 4 reads: "The description in writing must in all cases correspond with the map, and the two taken together must have the substantial certainty and precision of a deed."

Through the columns of ENGINEERING NEWS I would like to inquire what is the most feasible method of making such a relocation.

ENGINEER.

THE price of Latham's Sanitary Engineering, English edition, is $12. A few copies of the American edition can yet be bought of Van Nostrand at $8; we have none for sale. Our stock of 60 cent Greene's Bridge Trusses is rapidly diminishing, and those who want a copy at that price must buy soon. Stamps are acceptable, and there is no need to register.

ENGINEERS' SOCIETIES.

ASSOCIATION OF COUNTY SURVEYORS OF OHIO.

THIRD ANNUAL MEETING.

We have received from Mr. Fred. J. Sager, preident of the association, a copy of the proceedings at the third annual meeting, held in Columbus, Jan. 11, 12 and 13, 1882. The first in order were the reports of officers and committees and the transaction of miscellaneous business. Members of the Association presented resolutions referring to legislation on various subjects incident to the profession. A bill is now before the Legislature looking to the broadening of the surveyor's field of operations and clearly defining his position and duties. One section provides that "There shall be a State board of examiners, to consist of three competent persons skilled in civil engineering, and residents of this State; the members of this board shall be appointed by the Governor, one for one year, one for two years, and one for three years; and all vacancies in said board by expiration of term, resignation or otherwise, shall be filled by the Governor; the certificate of said examining board shall authorize the Governor to commission the holder thereof to practice land surveying in this State; and upon the presentation to him of such certificate, the Governor shall issue to the recipient of such certificate such commission." The following clause provides for the meeting of the examiners at Columbus, there to examine applicants as to their proficiency in land surveying. Each commission is to be recorded in every county in which the holders desire to make a survey. A bond of $2,000 must be deposited with the auditors of the county in which the holder resides. Each surveyor thus commissioned shall be empowered to take acknowledgments, administer oaths and take testimony regarding marks or monuments.

The following persons were elected officers for the year 1882-3: President, F. J. Sager, Vice-President, Jonathan Arnett; Second Vice-President, F. M. Davidson, Corresponding Secretary, W. C. Rowe, Recording Secretary, and Treasurer, Benj. Thompson; Executive Committee, C. W. Shoemaker, J. T. Buck, F. A. Born, D. W. Pampel and Jonathan Arnett; Legislative Committee, F. J. Sager, J. Arnett, J. B. Gregory, R. S. Paul and B. F. Bowen.

Mr. R. W. McFarland presented a communication detailing a simple and accurate method of finding the true meridian. Papers were presented by Mr. F. M. Davidson on Land Surveying and its phases; by Mr. J. Arnett on Magnetism and Magnetic Variation; by Mr. Fred. Howell, on The Office of County Surveyor; and by Mr. B. F. Bowen on Bridges.

STEEL SPECIFICATIONS.[*]

CHEMICAL COMPOSITION.

What modifications will be necessitated in specifications by the introduction of steel into engineering structures? It will generally be conceded that to the designer must be left the selection of quality, with special reference to the work to be done. To him it must also be left to decide where the lines between economical use of iron and of steel must be drawn. In this respect American engineers have many and great advantages over their English *confrères*—not the least of which is that we are not hampered by "Board of Trade Rules," "Admiralty Rules" and other circumlocution-office rules. The English "rules" allowing iron to be strained to 5 tons in tension, and steel only to 6 tons, would be simply prohibitory, with our ruling prices, to the use of steel in long-span bridges, where lightness is one of the most important considerations. It is the increased amount of mechanical work to which the steel must be subjected in bridge construction and shipbuilding that constitutes one of the most important points to be taken into consideration in the choice of material. These structures are composed of a series of members, subjected to unequal stresses, differing in degree and kind. Shapes vary widely, and are in many cases the result of very considerable mechanical work, and altogether the conditions of service are radically different from the uniform duty to be performed by rails or ship plates.

The specifications for the steel of a large bridge, properly proportioned, will therefore call for a number of grades of the metal, and cannot be taken indiscriminately from hundreds of tons of metal made from about the same raw material and by about the same process, or rather methods of manipulation. That the manufacturer cannot make structural steels for the price of steel rails is, of course, evident, and experience alone will ultimately enable us to harmonize the demands of the designer and the wishes of the steel maker who can furnish larger quantities of one grade at a lower grade than numerous small lots under detailed specification. It is, therefore, obvious, considering the intimate relations that exist between chemical composition and mechanical properties, that the engineer must have a voice in the construction of the formula by which the steel for his structure is to be made.

The writer is fully aware that steel manufacturers do not generally concede this, and some even look upon the introduction of chemistry into specifications as an encroachment upon their prerogative. They argue that the chemical composition is of no value to the engineer, as the physical properties are all that the latter has ultimately to rely upon. This is true in a limited sense only, and refers merely to the completely finished product. But the steel has to be worked into eyebars, has to be punched, riveted, sheared, shaped, hammered, annealed, etc., after it leaves the manufacturer. True, a variety of physical tests so extensive as to cover all these points might readily be devised by the engineer, but it is doubtful if the steel maker would not be put to greater inconvenience by being obliged to hold his mill pending such determinations, or to greater risk by turning out his product ahead of them, than by simply acquiescing in specifications which look to excluding, primarily, recognized elements of danger and failure.

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[*] From "Structural Steels," by Albert F. Hill, in *The Iron Age*.

The engineer, having determined upon the strength and resiliance of the material suitable for his purpose, and knowing the deleterious influence of certain elements, and the source of annoyance they may subsequently become in the working of the material after it has left the maker's hands, has a right to limit their presence in the steel to a minimum, besides prescribing the physical tests the steel shall stand. All that is to be considered in this connection is how far the engineer may define both chemical composition and physical qualities, and still leave the manufacturer full scope to meet these requirements without any particular hardship and without enhancing the cost of production. These conditions will probably be best fulfilled by leaving the specifications for analysis incomplete. For instance, suppose the engineer desires steel bars which will have to be subsequently worked into eye-bars. The steel will have to undergo several times reheating, forging and annealing before it leaves the mill. We know that silicon acts as a precipitant, and will displace the carbon from its combination with the iron at a red heat. This element must therefore be reduced to a minimum. On the other hand, the presence of maganese in allowable ratio will be desirable rather than otherwise. Moreover, provision must be made for the unavoidable loss in strength consequent upon the several manipulations mentioned. Supposing it is therefore required that the steel of such bars shall have the following physical properties:

Ultimate tensile strength per square inch, pounds	85,000
Elastic limit at, pounds	45,000
Elongation, per cent.	20
Modulus of elasticity not more than, pounds	31,000,000
Cold bending, degrees	180

There will be no particular hardship involved if the specifications require, primarily, that such steel shall show to analysis not more than

Phosphorus	.05
Silicon	.04
Manganese	.50
Sulphur, copper, etc.	.01

thus leaving the manufacturer free to vary the carbon percentage in proportion to the other elements, and to the extent necessary to produce or to meet the physical requirements. The finished product out of such steel—supposing all mechanical treatment to have been properly performed—will probably correspond very closely in its results to those obtained with about .30 carbon steel.

While a classification of the product in accordance with the carbon line is probably most easily understood by both engineers and makers in its general meaning, and therefore of great value, to specify simply the carbon percentage without reference to the ratio of the other elements would be worse than useless, while to specify the carbon, and to limit at the same time the percentages of the other elements, would throw the responsibility for the physical properties of the steel entirely upon the engineer.

Speaking in a general way, the range of steels most suitable for bridge construction will be found to lie between from .20 to .50 carbon, and several of these grades may advantageously be employed in the same structure—the lowest grades for members subject to transverse strains and fatigue from shocks, the medium grades for tension members, and the high grades for members under compression. This adaptation of the grade of the steel to the peculiar service for which it is required, constitutes the greatest advantage steel construction possesses, and if properly availed of, leads to the best proportions in the structure.

Much more light than we have at present on this subject is needed ere general rules for chemical composition can be even approximately laid down, and if the intelligent use of steel in structures is to become the rule rather than the exception, it will require cordial co-operation of designer and manufacturer. Only a full knowledge of the other's wants and means will enable each to solve intelligently the problems and elaborate the details pertaining to his field of practice.

BASIS OF STRENGTH.

If all the advantages that steel offers to the designer are to be reaped, our present methods of dimensioning must undergo considerable modification. Foremost among the changes most imperatively demanded, is the establishment of a basis for safety factors which shall truly represent the margin or ratio between the working load and the limit of usefulness of the material for structural purposes. This limit is reached at the point at which "permanent set" first takes place—generally, but erroneously, called limit of elasticity—and which might therefore be properly called the "safe strength" of the material. It is being more and more generally recognized among engineers that it is a fallacy to claim for a structure a factor of safety of six, because the maximum recurring stresses in it are about one-sixth of a load, the single application of which would produce failure. It will therefore be well to adopt primarily this "safe strength" or elastic limit as the basis to which the factors of safety are to refer. The knowledge of the ultimate strength is nevertheless of great importance, and will always, in a measure, guide the determination of the safety factor, but not by making it the basis for the latter. The intimate relation existing between strength and ductility finds further expression in the gradual increase of the ratio between elastic limit and ultimate strength, as the latter increases, so that this ratio of elastic limit to ultimate strength may be fairly said to be in inverse ratio to the ductility of the material. Now, the greater the range of elasticity in a material, the more ample warning it gives of its failing strength, and vice versa. Therefore this ratio of elastic limit, to ultimate strength may be used as a guide in the quantitative determination of the requisite factor of safety for a given structure or its different members. For instance, referring to the "safe strength" or elastic limit as a basis, a factor of 2 will probably be found quite sufficient in cases where this ratio of elastic limit to ultimate is as 1 : 2; but where we find this ratio larger, we shall also find a corresponding decrease in the ductility of the material, hence less warning of impending failure, and must therefore adopt a correspondingly larger safety coefficient.

Another point for consideration is the fact that the ratio of thickness to width exerts a considerable influence upon the tensile resistance. This will require to be taken into account in dimensioning very wide and comparatively thin eye-bars, and also in accepting test results of small specimens as a criterion of the strength of plates. In general, specimen tests will always give results from 10 to 15 per cent. in excess of what the full-sized members will show.

Altogether, dimensioning in steel, while it affords the designer exceptional opportunities for display of engineering skill, requires also careful consideration of the susceptibility of the material to treatment, and hence no attempt ought to be made to establish a uniform basis of strength, as has been done in iron construction, nor could any such attempt be fruitful of anything else than confusion and obstruction. Designers in steel will have to establish and to change constantly the basis of strength calculation with the adaptation of the greatest number of physical properties to the particular structure under consideration.

PHYSICAL TESTS.

To prescribe tests in such a manner that they shall be at once exhaustive indications of the characteristics of the material, and yet not become burdensome, is no easy task. It may be accepted as a general rule that specimen tests are of small practical value outside of the field of scientific investigation, and if made in sufficient number to become really serviceable in the course of a construction, their preparation in lathe and planer will take a great deal of time, and be a considerable item of expense. Of course, they cannot be altogether dispensed with, and are in some cases even the readiest means of settling a question at issue. For instance, if it is suspected that the steel has roll-hardened, or that it is burnt, duplicate specimens, one tested as it comes from the rolls, the other after annealing it, will tell a short, but very effective, story.

For the determination of modulus of elasticity carefully prepared specimens ought to be used, and the writer would call attention right here to the vital importance of this so generally neglected factor in strength determinations. Full-sized eye-bars are readily tested up to 1¼ to 1½, the maximum stress they are dimensioned for; this is fully within the elastic limit, and ought, therefore, to occasion no loss of material, and give at the same time definite indications of both strength and workmanship. For plates and angles the cold-bending test—before and after annealing—is the easiest of application, and, after all, the most decisive.

Where large presses are available, transverse tests of beams within the elastic limit and up to double the amount of calculated or allowed deflection, are readily and quickly made. The cutting of specimens from web and flange for tests is slow and expensive work, and tells but little. The drop test (under a hammer in guides and with equal heights of fall) will give very conclusive data, especially if comparison is made between the behavior of annealed and unannealed beams. Compression tests of small specimens are almost valueless, unless at least the proportion of length and diameter in the full-sized member is closely reproduced. An exhaustive series of steel-column tests is most needed at the present moment. Testing, of course, must include the effects of punching, shearing and annealing, but very few specimens, even in a large structure, will suffice for very good conclusions, if the other and preceding tests have been carefully made. Testing, without taking into account every detail that exerts influence, is apt to lead to serious errors, and is merely a useless waste of time and money.

INSPECTION.

Every engineer knows that no specifications were ever drawn for an important structure from which more or less deviation had not been made during the progress of the work; this being the case, it becomes evident that the inspector ought to be a man of large practical experience, as well as of sound theoretical knowledge, so that both constructor and manufacturer may be able to rely upon the soundness of his judgment. Unfortunately it is no uncommon experience in steel work to have an inspector reject in one case material which, though not quite complying with the letter of the specifications, is quite serviceable and acceptable, and in another case accept work and material which, though apparently in accordance with specifications, is unfit for use, and would be promptly rejected by the maker himself if he had an opportunity to decide.

In steel construction, probably more than in any other, the inspector is a necessary adjunct to the constructor; but ripe judgment, that familiarity with the material which can only be acquired in the mill and shop, and a thorough knowledge of the wants of the structure, coupled with the faculty of utilizing to the fullest extent the given means of the mill or shop, are absolute requisites for his usefulness. The sending of inspectors to steel works for educational purposes will be found fully as expensive to their employers as it is likely to be annoying and productive of loss to the steel maker, though it does occasionally afford some quiet amusement to superintendents and foremen.

The working of steel in every stage requires care, and, above all, intelligence, and the men engaged in it must be impressed with the necessity for careful manipulation and rational treatment.

PULLMAN SEWERAGE.

At the meeting of the Western Society of Engineers on Tuesday, a paper was read by Benezette Williams, late city engineer, and now in charge of the engineering work of Pullman, on "The Pullman Sewerage." The question of the disposal of the sewage of the new model town was a perplexing one, and Mr. Williams was authorized to make such investigations as might be necessary to devise a plan which should be in keeping with the other ambitions of the town. In view of the fact that the system finally adopted, and now in successful operation, possesses many new features, the substance of Mr. Williams' paper, describing it in detail, is given below. The paper is introduced by a description of the town, and a brief discussion of the merits of separate and combined systems of sewerage; that is, for rain or surface water, and sewage proper. It then proceeds as follows:

Pullman is a place for which the separate system is particularly well adapted, and for the following reasons: The site of the town is almost level, much of it not more than 7 or 8 ft. above Lake Calumet, making it impossible to obtain a gravity discharge to any other body of water than Lake Calumet. This lake is shallow—ranging from 1 to 8 ft. in depth. It is about 3 miles long and 1½ miles wide. It drains a small area, and is connected with Lake Michigan by the Calumet River. The river, however, which drains a much larger area than the lake, does not run through the lake, but is connected therewith by a small channel, through which the water flows from the lake to the river, or from the river to the lake, according to the varying conditions of winds and floods. In the absence of any adequate means of purifying itself, Lake Calumet is wholly unfit for a receptacle of sewage The small elevation of Pullman and the great distance to Lake Michigan render a gravity discharge thereto impossible. When a town cannot get rid of its sewage by a gravity discharge, the alternative is to use a pump. When a pump has to be relied upon, the exclusion of rain water from the sewers becomes almost a necessity, and when, as in this case, the surface-water can readily be carried off by a system of drains made for that purpose only, it adds strength to the reasons for fixing upon the separate system, which in this case was adopted for the reasons given, independently of its supposed sanitary merits.

The question of disposal, however, was not one that could be settled by the force of conditions. In selecting the place for and deciding upon the manner of disposal, there was room for a greater range of opinion and judgment, though, even in this the question was soon narrowed down to two parts. Lake Michigan could be reached with a pipe 6½ miles long, and, by pumping, the sewage could readily have been discharged therein The only alternative was land purification in some shape.

It was found that suitable land could be had three miles away, the title to which had been acquired by the Pullman Land Association. Estimates showed that a pipe could be laid to this land, a farm sufficient to dispose of the sewage of ten thousand people prepared, and suitable farm buildings erected for a less outlay than would be incurred in laying a pipe to Lake Michigan. It was believed that the farm could be made to pay expenses and the interest upon the money actually expended upon the farm proper, which would make the scheme of land purification considerably cheaper than the lake disposal, to say nothing of the objection felt to further contamination of a body of water that is already overcharged with filth. The plan of sewerage was determined upon, and the laying of the sewers begun, in August 1880, soon after the writer was employed as engineer of the water and sewerage works for Pullman. Six months later, in February, 1881, the method of disposal was decided by the adoption of the sewage farm projects. October 18, 1881, the system was put into operation on starting the sewage pumps.

The system of sewerage is designed to reach a tract of land two miles long and an average of something more than a mile wide, comprising about fifteen hundred acres of land. To drain this district three mains have been provided, which center at the water tower. The mains leading from the north and from the west are 18 in. in diameter, and the one leading from the south is 15 in. in diameter. These mains are laid with a grade of 1 ft. in 1000 ft. The 9-in laterals are laid with grades varying from 2 to 4 ft. per 1000 ft., and the 6-in. laterals with grades of from 4 ft. to 6 ft. per 1000 ft., according to circumstances, the maximum grade in each case being the one size in all but special cases. At their starting point, the mains are about 16 ft. below the general grade of the town, the extreme ends of the 6-in. sewers in the alleys being about 7 ft. below the yards in the rear of the houses. The ground in which the sewers are laid is a hard, tough, drift clay. Man holes are 160 feet apart on the mains and generally 2 200 ft. apart on the laterals, being built also at every change of grade and direction. They are covered with a ventilating iron cover, with a trough or channel under the openings to catch dirt.

In all there has been laid at Pullman up to June 1, 1882, the following amounts of sewers of the various sizes, exclusive of house connections:

4,356	lineal feet of	18-in.	sewers.
3,176	" "	15-in.	"
680	" "	12-in.	"
3,600	" "	9-in.	"
12,000	" "	6 in.	"
500	" "	4-in.	"

24,312 lineal feet in all.

In all cases outside of houses—in mains, laterals, and house drains—salt-glazed, vitrified clay pipes of the Akron make have been used. Within the houses, soil-pipes are of iron, and were put in by the Durham House-Drainage Company, of Chicago. The vertical soil-pipes are wrought iron, coated with coal-tar, varnished, put together with screw joints, and the horizontal pipes are cast iron, with lead joints. The vertical pipes are 3 in. in diameter, and the horizontal pipes 4 in. in diameter. The horizontal pipe connects with the outside sewer without a trap. The vertical pipe runs through the roof, in all cases, full size. In most cases each soil-pipe has two or more water-closets connected with it. A pipe placed in a partition between two houses generally takes the soil for both houses. In cases of three-story flats, one pipe frequently has six water-closets connected. By these departures from the usual size of pipe and the usual manner of setting closets, a great saving in cost has been effected without inconvenience of any kind.

There have been—out of several hundred 3-in. soil-pipes that have been in use from two to eight months—perhaps six or eight cases of stoppage. But in every instance the stoppage was due to obstructions that got in during construction, and never to the use of a small-sized pipe. The results would unquestionably have been the same had 4-in. pipes been in use.

The sewerage system drains into a sewerage reservoir in the base of the water tower, the whole middle of the foundation of the tower having been excavated to a depth of thirty feet and all the space up to the grade of the sewers, not occupied by the walls, being used for storage. This holds about 200,000 gallons. Increased storage capacity can be had when needed by excavating a side chamber. It is expected that the present capacity will suffice for 8,000 population. Ventilation of the sewage reservoir is secured by means of eight flues lined with 12-in. sewer-pipe, built in the buttresses of the tower and opening at a height of 165 ft., and, also by a 20-in. pipe leading to the large chimney of the car-shops. The ventilation thus secured is perfect. The reservoir is arched over with groined arches, forming a floor for the sewage and water pumps, 10 ft. below the surface of the ground. The sewage pumping engines are direct-acting, compound-condensing, with piston pumps, each having a capacity of 2,500,000 gallons in twenty four hours. They were made with the special object of getting machines which would pump everything to be found in sewage, either of an ordinary or an extraordinary character. It was considered desirable to avoid screening or settling the sewage at the reservoir. All the sediment which collects in the reservoirs by incidental settling is from time to time washed loose with a hose and passed off with the liquid sewage. In order to accomplish this work a rubber valve of special make is in use. Without taking time to describe the valves now, it will be sufficient to say that thus far they are working to great satisfaction. Cotton waste, large cloths, sticks and blocks of wood have passed through the pumps frequently; indeed, many such substances are daily passing without injury or inconvenience. Barring the riveting of two parts of the rubber together, where they were at first imperfectly joined, no repairs have been needed, and there is nothing to indicate aught but a long life for the valves. The pumps were made by the Cope & Maxwell Manufacturing Company, of Hamilton, O.

The sewage is conveyed to the farm by a 20-in. cast-iron main, nearly three miles long. The farm end of this main connects with a closed, screening-tank, by means of which all material that will not pass through a screen of ½-in. mesh is intercepted. The tank is 6 ft. in diameter and 24 ft. long, made of ¼-in. boiler iron. It is set vertically, with its lower end high enough above the floor to admit of a wagon being driven under it. The material intercepted by the screen is lodged in the lower part of the tank, from which it is removed from time to time. On leaving the tank, the sewage passes through a pressure-regulating valve, which limits the pressure that comes upon the pipes leading to the fields to about ten pounds. As an additional precaution against high pressure, an overflow-pipe is provided, which will absolutely, under all conditions, prevent the pressure from rising above the limit. This pipe comes into play occasionally when the pumps are started suddenly without giving the valve time to act. The valve is purposely made to act slowly, in order to avoid the influence of pulsations in the engines and irregularities from other causes. A pressure on the interior of the thin steel disks above the valve raises the plunger, and closes the ports through which the sewage passes. If the pressure falls the ports open gently. Vibrations of the valve from sudden changes of pressure are prevented by a plate between the valve and the steel disks, through small holes in which the sewage has to pass in order to increase or diminish the pressure on the disks. The upper part of the tank, above the screen, is an air chamber, and answers the usual purpose of such an adjunct in preventing shocks from irregularities in the pumps, or by the sudden stopping of the flow of sewage. The tank and valve are housed in, and can be kept warm to prevent freezing in cold weather. The reason for introducing the pressure-regulating valve between the screening tank and the field is to make it possible to distribute sewage safely through clay sewer-pipes under pressure.

The main distributing pipe is 18 in. in diameter. From this main four lines of 9-in. pipe, 315 ft. apart, are laid across the field. Every 320 ft., on each line of 9-in. pipe, a hydrant is set, thus giving one hydrant to each 2½ acres, or thereabouts. On an 80-acre tract, which is now being underdrained, it is probable that two lines of 12-in. pipes will be used to distribute the sewage. This tract lies more favorably for surface distribution than the one prepared last year, and it is believed that fewer lines of pipes and hydrants will be sufficient. The pipes laid last year for distributing the sewage were of Akron make, with socket joints. The first pipes ordered were made with 3-in. sockets, but it was afterward found that sockets of ordinary depth would make a tight joint.

Before laying the pipes it was thought best to make a test as to whether weak or cracked pipe could be detected by ordinary inspection. An application of hydraulic pressure developed the fact that no inspection possible to apply could be relied upon. Many pipes that looked rough and full of fine cracks, that would ordinarily be rejected, were found to be among the best. While, on the other hand, the clearest ringing and best appearing pipes were often the poorest. These results made it necessary to apply the test generally. The test applied was 20 lbs. pressure per square inch. It was soon found that this pressure would break too large a proportion—about two-fifths of the 18-in. pipe, so it was decided to lay the main in concrete without testing. The 9-in. pipes stood the test better, about one pipe in four being broken in the operation. This loss could be stood and still the sewer pipe be much the cheapest thing that could be used for the purpose. It was a noticeable peculiarity of the pipes that 75 per cent. of those that failed broke below 10 lbs. The bed of concrete around the 18-in. main was from from 4 to 6 in. in thickness. The bottom was generally made of the Utica cement mortar and broken stone, while for the top and sides Portland cement was used. The 9-in. pipes were laid with stiff Portland cement mortar mixed with an equal quantity of sand. A hemp gasket was tried at first, but it was soon found that the quickest and best way in every respect to make a joint was to make a bed of mortar on the lower half of the socket and insert the next pipe; then, with the trowel, to force the mortar into the annular space on the top until the mortar was forced through into the inside. Out of 7,500 ft. of pipe laid in this manner there has been found but one case of defective joints, and this was caused by a heavy rain during the pipe-laying.

The general conclusion from this experience in the use of clay sewer pipes to carry fluids under pressure is that for light pressure from 10 to 15 lbs. the smaller-sized pipes are well adapted to the purpose if proper care is used in selecting them and in securing the joints as they are laid. I consider it by no means certain that sizes up to 18 in cannot be profitably used, as I do not think that the lot of pipe of this size that we had was of the best quality. Thin pipes seemed to give better results than thick ones.

The system of underdrainage on 60 acres prepared last year consists of one main underdrain, from 6 in. to 12 in, in diameter, of sewer pipe, laid north and south, and emptying into a ditch that discharges into Lake Calumet, and of parallel lines of common tile, 2 to 4 in. in diameter, laid to an average depth of 3½ ft., and an average distance of 40 ft. apart. The tile were laid with strips of tarred paper tied around the jointe. Ten ft. of tile were strung on a pole at the side of the trench, the joints wrapped, and the whole 10 ft. put in place at one operation.

As to any of the general results of sewage farming, it is too soon to speak from experience upon the Pullman farm. The ground was covered with a tough sod, much of it a coarse, wild grass, and was plowed late last fall. The sod is still so tough that it is impossible to put it in proper shape for irrigating the crops. Then the spring has been so backward, owing to wet and cold, that no kind of crops are much advanced in this region. Difficulty is also being experienced by the grass starting to grow upon the land where sewage has been applied during May. It is intended to underdrain, a rod apart, a portion of land best adapted to sewage purification for filter beds, to be used as a safety valve, when if applied to ordinary crops the sewage would be an incumbrance. Upon these filter beds some of the coarser kinds of crops can be grown. As soon as the farm has really been fairly started, which, owing to the reasons given, cannot be before next year, I see no cause to doubt the success of the enterprise.

There is one feature of the system of direct pumping of the sewage at Pullman which may be of interest. The pumps, screening tank and pressure-regulating valve are so arranged and are so dependent one upon another that notwithstanding the use of clay pipes for distributing the sewage the workmen on the farm can control the quantity of sewage received with perfect safety. They close and open hydrants to any desired extent and vary the amount of sewage discharged almost as they please without danger or inconvenience. The operation is this: If the sewer is flowing at any given rate and one or more outlets be closed the effect is partially to close the pressure-regulating valve, by a slightly increased pressure on the distributing pipes, and to transmit from the valve, through the force main, an increased pressure to the pumps, which are provided with a steam regulator that reduces the pressure of steam admitted to the cylinders. In order to avoid all possibility of injury to pipes or pumps in this operation, a stand-pipe with two overflows is provided at the pumps, as well as one at the regulating valve, so that there is an absolute guarantee against damage from the failure of any mechanical appliance. The stand-pipe connected with the pump-main in the tower is, measuring from datum, 54 ft. high to the first overflow, and 90 ft. high to the second overflow. These overflows are connected with a pipe which returns the sewage to the reservoir below the pumps, so that, if every outlet is closed at the farm, the pumps could continue to run with freedom. Should the pressure-regulating valve fail to perform its functions, the overflow pipe then will protect the clay distributing pipes from undue pressure.—*Chicago Times, June 9.*

NOTES.

THE RAILROAD BUILDERS.

The most important to us of all the railroad building now in progress is that in Mexico, which will soon bring us into commercial relations with her nine millions of people.

The Sinaloa & Durango Railway, which is to connect the Pacific port of Altata in the State of Sinaola with the city of Durango on the main line of the Mexican Central, will be completed to Culiacon about July 1. The grading is already finished to that point.

The road from Merida to Valladolid is advancing rapidly. This appears to be a recent project. It is not denoted on the maps which we have seen. Yucatan is a very promising State, lying directly south of the jetties.

The *Rio Grande Valley*, a paper published at Brownsville, Texas, says that the Matamoros road is now completed nine miles. This is one of the spurs of the Mexican National, and runs up the river to Mier, whence it strikes southwest into the hill country to Monterey on the main line.

Rails are now laid from Guaymas toward Nogales, on the American frontier, at least 190 miles.

From Tampico on the Gulf to a point called Buena Vista, the road toward San Luis Potosi is running; it is thirty-two kilometers from Muralillo to Buena Vista. The completed track is therefore above twenty miles.

The main line of the National was 106½ miles beyond Laredo yesterday (May 26), and will arrive at Villaldama, 109 miles, Monday. The National has done splendidly lately.

The Puebla & Izucar de Metamoros road is progressing, twenty-two kilometers (about 14 miles) being laid.

More than 32 kilometers (about 20 miles) of track is now ready on the San Martin Texmelucan road.

The extension of the Morelos road from Cuantla to Acapulco has to be commenced within four months.

The sum of all the subsidies, State and Federal, on all the lines of the Mexican Central is $30,923,400. The concessions aggregate 3,234 kilometers (or 2,009 miles). This does not include the Sonora line, from Guaymas to Nogales, which is now consolidated with the Atchison, Topeka & Santa Fe.

The subsidies of the National aggregate above $20,000,000.

The subscriptions recently invited by the National and Central have both been taken, $14,000,000 cash for the first and above $6,000,000 for the other. The Central subscriptions were more than $2,000,000 in excess of the amount required. The financial condition of both roads now warrants the hope of steady and rapid work. The National's bonds are advancing in the market.

A report being current in the City of Mexico that Gen. Grant had not succeeded in raising the necessary capital for commencing the construction of the Mexican Southern Railway, the *Two Republics* states that Gen. Grant said recently that he did not intend to push the construction of the road until the City of Mexico is connected with the United States by rail.

The City of Mexico is the most northerly point on the Mexican Southern. It is not stated whether the beginning of work awaits the arrival of the Gould DeGress road from Laredo via Victoria, or will proceed as soon as it can obtain transportation by the Central or National line. The Mexican government has approved the plans and profiles of the second hundred kilometers of the Gould-DeGress line south from Laredo.—*New Orleans Picayune, June* 3.

COAL MINING WITH LIME.

At last there appears a possibility that the terrible loss of life which annually occurs in these isles through mining accidents will soon be sensibly reduced. At the present meeting of the Iron and Steel Institute Mr. Mosley read a long and instructive paper on a new method of winning coal. The principal feature is that cartridges containing lime in a highly caustic condition are employed instead of explosives. After one of these has been rammed down tightly to the bottom of the shot-hole and "tamped," water is injected into the cartridge by means of a small force-pump and hose, and a rapid generation of steam then takes place, gradually rending asunder the coal in all directions, and, in short, performing all the duties of gunpowder or dynamite. It is too early as yet to say whether this process will prove applicable in all cases. When lately tried at the Shipley collieries it more than answered expectations, having worked 140 tons more coal in 100 hours less time than the wedge method did in the next "stall." Commercially, therefore, its success seems to be demonstrated under the conditions which exist at the Shipley pits. It is further claimed for this invention, apparently on good grounds, that it gives absolute immunity from gas explosion, as no fire or flame is generated; that it does not create any smoke or noxious odor; that unskilled labor can work it, and that the men engaged always have plenty of time to get away before the coal begins to fall. Should only a portion of these pretensions be established, coal winning by lime will assuredly replace all other methods.—*London Globe.*

LITERATURE.—In the *North American Review* for July, the leading article is a profound and sympathetic study of "Emerson as a Poet," by Edwin P. Whipple. The author has scarcely a word to say about forms and modes of expression, and cheerfully concedes that Emerson had command only of two or three meters; but he brings all the resources of his extraordinary critical acumen to prove that as a seer, as one who has intuition of the deeper truths of nature and the moral universe—in short, as a poet in the highest sense of the word—Emerson must take rank with the greatest geniuses of all time. In "Hydraulic Pressure in Wall Street," a writer who withholds his name, but who manifestly is no novice, exposes many of the tricks and devices by means of which fictitious values are created, and the unwary lured daily to ruin. Désire Charney contributes the eleventh article in the series on "The Ruins of Central America," and records the crowning triumph of his exploring expedition, namely, the discovery of a great ruined city in the hitherto unexplored country of the Lacandones, Guatemala. There are two papers on the civil service question: one, "The Things Which Remain," by Gail Hamilton, who labors to relieve the civil service from the aspersions cast upon it on account of Guiteau's crime; the other, "The Business of Office-Seeking," by Richard Grant White, who forcibly portrays the moral ills that come from the perennial struggle for place. Finally, Francis Marion Crawford, son of the eminent American sculptor, writes of "False Taste in Art," and indicates certain directions in which art-culture might be developed under the conditions of life existing in the United States. The *Review* is for sale by booksellers and newsdealers generally.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

WORKS FOR HACKENSACK, N. J.—Rapid progress is being made toward the completion of the water-works for the above-mentioned city. The pumping station is located on the Hackensack River. The plant consists of two Worthington engines of 3,000,000 gallons capacity each. The water will be forced through 14 miles of 20-in. cast-iron pipe to a reservoir of 15,000,000 gallons capacity, located at Weehawken, the elevation being 180 ft. above high water. The consumption has been estimated at 3,000,000 gallons per day. C. B. Brush, of the firm of Spielmann & Brush, Civil Engineers, of Hoboken, is chief engineer, and John F. Ward contractor. The work will be finished by Nov. 1, 1882.

WATER CONTROVERSY AT NEWPORT, R. I.—A dispatch from Newport says: There was a hearing before Judge Carpenter this morning on the water question. George H. Norman, Lieutenant Governor Fay, L. D. Davis and ex-Mayor Slocum testified that more water was needed, while Colonel George E. Waring, Jr., was the only witness who certified that the water was impure and not fit to drink. The testimony of several witnesses was called in rebuttal to show that the water was pure, all the witnesses having resided on or near the pond which the city gave George H. Norman for the city's water supply, that gentleman having built the water-works. The real object of the fight is to prevent Norman from confiscating the land near the ponds, according to the provisions of the charter granted him. Later—Judge Carpenter decides in favor of Mr. Norman, who can now go ahead and take land for the use of the city water supply. Of course a board of arbitration will decide what damages he must pay. The decision gives great satisfaction.

SAN FRANCISCO WATER RATES.—From a local paper we clip the following: The Committee on Water and Water Supplies presented an order to the Board fixing the water rates. The order was based on the order introduced by Mr. Fisher, eliminating the provisions which the late decision of the Supreme Court holds to be unconstitutional. The new order differs from Mr. Fisher's order in providing for the payment of $7,000 a month by the city for water used for family purposes in the public buildings, and making a reduction to that extent in the rates to be paid by consumers. The order submitted provides for a payment of $84,000 per annum for water used for family purposes, and reduces the rates as presented in the Fisher order 7 per cent. The order also provides for a reduction of 17 per cent. from the rates as at present fixed by the Bayly order. The rates fixed by the order are as follows: For buildings occupied by a single family, covering a ground surface of from 600 to 700 square feet, one and two stories, $1.35; three stories, $1.50; four stories, $1.70; five stories, $1.85; 700 to 800 square feet, one story, $1.35; two, $1.50; three, $1.70; four, $1.85; 800 to 900 square feet, one story, $1.50; two, $1.70; three, $1.85; four, $2; five, $2.20; 900 to 1,000 square feet, one story, $1.60; two, $1.85; three, $2; four, $2.20; five, $2.35.

No single rate to be less than $1.35. For all houses one story in height, covering a greater area than 1,000 square feet, there shall be added 17 cents for each additional 200 square feet or fractional part thereof, and the further sum of 17 cents for each additional story; and where a house is occupied by more than one family three-quarters of the foregoing rates will be charged in addition. The order was referred to the Board as a Committee of the Whole.

MAY DISPOSE OF ITS GAS-WORKS.—The City Solicitor of Philadelphia has decided that there is nothing to prevent the sale or lease of the works.

THE GAS QUESTION.—Twenty-five years ago last night the Covington Gas Company contracted with the city of Newport to furnish them gas for twenty-five years, and their contract expired last night. A few weeks ago an arbitration committee was appointed to fix the value of the stock and fixtures of the Covington Company in Newport, which was to be purchased by the Newport Company. The arbitrators fixed the value at $82,900. Yesterday the representatives of both companies held a meeting in this city, and the Covington Gas Company tendered to the Newport Light Company a deed for all the pipes, meters, etc., and demanded in lieu thereof $82,900, as specified in the report of the arbitrators. The Newport Company refused to receive the deed; but said that they would take the mains, pipes, service-pipes, posts, meters, etc., and pay on account $31,555. The Covington Gas Company took the money on account, and both parties agreed that the reception of the money by the Covington Gas Company, and the reception of the mains, meters, etc., by the Newport Company, was not to prejudice the right of either company in future litigation. Suit will be brought by the Covington Company against the Newport Company for the remaining $51,000, which, of course, will be resisted by the Newport Company. The Newport Company claims that the gas-meter and grounds and exhauster were not to be included as fixtures. The Newport company were represented by Mr. John A. Williamson, Mr. Johnson and Judge O'Hara, and the Covington Company by Hon. John W. Stevenson, Hon. George H. Pendleton, Hon. John F. Fish, Amor Shinkle, Esq., and Bradford Shinkle, Esq., while Andy Hickenlooper, Esq., of Cincinnati, was a silent spectator on the outside. The Covington Gas Company turned off their gas in this city yesterday, and at 8 o'clock last night the city was nearly in darkness, until the Newport company made their connections with the Cincinnati Company, which was done about 9 o'clock. The gas is not over brilliant. A special meeting of the City Council was held last night to ratify the contract with the Newport Company; but they postponed action until next Thursday night. Mr. J. C. Dreber has his gas-works completed, and the gas gives a light of 24-candle power. He will have his buildings lighted in full to-night, to give the public a chance to view his beautiful works by gaslight.—*Cincinnati Enquirer, June* 9.

LEAKY RESERVOIR IN PHILADELPHIA.—Complaints have been made for some time that, in consequence of the poor work upon the lining of the Wentz farm reservoir, in the Twenty-third ward, water has constantly leaked through and seriously damaged the adjoining farm lands. A suit has been brought against the city by a farmer named Peters to recover $20,000 damages for injuries he claims to have sustained to his crops and land by the constant dampness caused by the leaking of the public basin.—*Times.*

BURSTED RESERVOIR.—The east side of the Portland (Me.), reservoir gave way on June 9, and an immense torrent of water poured down Vaughan into other streets, tearing up pavements and curb stones and flooding cellars. In 30 minutes 6,000,000 gallons of water escaped. No one was injured. The damage is $5,000. The reservoir had recently been pronounced safe, but the water worked through first at the top, between the blue clay and stone parapet.

WATER-WORKS EXTENSION.—Work was commenced yesterday on the foundation for the new high-service engine at the water-works. Reference to the magnitude of the new water-works extension has been made on several previous occasions, but it will be more clearly understood when it is stated that the foundation alone will cost $90,000, and the building to be constructed upon it $250,000, and the engine to be placed in it about $14,000. The large cost incident to the foundation and building is occasioned by the massive stones and heavy iron to be used in the structure. The Water Commissioner is of the opinion that the new engine will arrive at St Louis about next October, and will immediately be placed in position.—*St. Louis Globe-Democrat.*

ADDITIONAL PUMPING MACHINERY.—One year ago the Dean Bros.' Steam Pump Works, of Indianapolis, furnished the water works at Edmore, Mich., with one of their steam pumps. They have just shipped another pump to the same place, which will double the supply. The water-works are owned by the village of Edmore.

ELECTRICITY.

LONG DISTANCE TELEPHONING.—European journals which have just come to hand print at length two complimentary dispatches sent simultaneously from Brussels to Paris. One of them was sent by telephone and the other by a Morse instrument over one wire at the same time. The invention by which this feat was made possible is that of M. Van Rysselberghe, director of the meteorological service of Belgium.—*Engineering and Mining Journal.*

RAILROAD TELEGRAPHING.—C. F. McGlashan, proprietor of the Santa Barbara (Cal.) *Press* has patented a system of railroad telegraphy for which he claims exceptional advantages. According to his circular the invention furnishes a practical method of establishing constant telegraphic communication between any number of moving railway trains and any number of stations. Ordinary telegraph wires, batteries and instruments are employed, and a regular telegraph office is placed upon each moving train. The principal feature is the use of two wires instead of one, in transmitting the electric current. Wheels or electric brushes attached to the moving train touch these wires, conveying the current from one wire to the instrument in the car, and returning it to the other wire, along which it passes until its destination is reached, when it is connected with a ground wire, and completes the circuit through the earth. The same current is made to pass through several trains by a simple method of switching at stations.

REGULATING WIRES UNDER AND ABOVE GROUND.—The committee on police and fire-alarm telegraph of Philadelphia reported in Select Council with a favorable recommendation the general ordinance to regulate the use of underground telegraph and electric light wires. One of the provisions is that the city shall have the use of one or more of the conduits for the police and fire alarm telegraph whenever she desires it free of any cost. Another provision is that after the passage of the ordinance any corporation, firm or individual owning or maintaining any lines for telegraphic, telephonic or electric lighting purposes overhead in the city shall be subject to all charges provided in the ordinance for underground wires.

ROUGH ON THE TELEPHONE.—A Cincinnati paper tells of Mme. Materna's introduction to the telephone as follows: "The telephone was another new thing. I called up Chris Ahrens and told him a lady wanted to talk with him, and the next minute they were at it. All about Germany and in German. Lord, how that telephone suffered! The paint fell off the wires, and some of those seven-cornered words nearly broke the box. When they got through the telephone fainted."

THE SOUTH AMERICAN TELEGRAPH.—On the 13th the Central and South American Telegraph Company announced that they expect to have their cable completely laid during this month and in operation soon. The cable between Payta and Saint Elena was finished in May. The land line across the Isthmus of Tehuantepec was completed a couple of days ago, and the extension to Galveston, Texas, a distance of 280 miles, was successfully laid.

STREETS, DRAINAGE, ETC.

TO BE REPAVED.—The Mayor and several prominent citizens of Springfield, Ill., recently visited Bloomington, to examine the street pavement of that city. Springfield having been incorporated under the general law, it now proposes to pave in a substantial manner the entire business portion either with cedar blocks or stone. An ordinance to that effect is now pending before the City Council.

STREET IMPROVEMENTS.—The Paterson (N. J.) Board of Aldermen, on Monday night, passed the tax ordinance by reaching a compromise, appropriating $40,000 for permanent street improvements, without stating what streets were to be improved. The first street paved will be Main street, and the pavement in Broadway, New York, will be taken as the model.

STREET DEPARTMENT OF SAN FRANCISCO.—Auditor Brickwedel has received the following estimates from Superintendent Graham for the Street Department's requirements for the fiscal year ending June 30, 1883: Street Fund—Labor on accepted streets, at $8,500 per month, $102,000; labor on sewers, $4,000 per month, $48,000; material, $120,000; street-sweeping, $54,000; rent of corporation yard and salary of keeper, $1,920; incidental repairs, $4,800; total from street fund, $330,720; salaries payable from general fund, $32,500; stationery from special fee fund, $800; repairs on county roads, $10,000.

RAILROADS.

A NEW RAILROAD IN MEXICO.—BOSTON, Mass., June 12.—A special to the *Advertiser*, from San Diego, Cal., says: "Another Boston railroad in Mexico, the 'Bee Line,' both ends of which are in the United States, is the last project practically begun. It begins at National City, three miles from here, at the present terminus of the California Southern Railroad, and runs southeast through Northern Mexico, 470 miles to Calabasas, in Arizona, running only twelve miles in the United States at the west end. Crossing lower California to the mouth of the Colorado River, thence across Northern Sonora and leaving it near the Eastern line, it enters Arizona and runs twenty-four miles to Calabasas, where it will connect with the Sonora Railroad from Guaymas, running northeast to a connection with the main line of the Atchison, Topeka & Santa Fé Railroad, at or near Benson, and will have an extension north from Calabasas to the main line of the Atlantic & Pacific Railroad by way of Prescott.

WORK IN THE SOUTHWEST.—NEW ORLEANS, June 15.—Four thousand tons of steel rails are now being discharged at College Point, sixty miles above this city, for the New Orleans & Mississippi Valley Railroad Company. The engineer corps is pushing forward in the direction of Baton Rouge through the sugar plantations on the banks of the Mississippi River, and track-laying will soon begin.

THE MEXICAN CONGRESS.—The Congress of Mexico has authorized the executive to build a railroad across the Isthmus to Tehuantepec with government money; there was also authorized an extension of the time for the drainage of the Valley of Mexico.

THE CANNON VALLEY SURVEY.—The surveyors of the Cannon Valley Railroad have made a preliminary survey from Faribault to Northfield, Minn. The route surveyed is on the west side of Cannon River and about 800 ft. east of the Chicago, Milwaukee & St. Paul road. The surveyors have not decided which way they will survey from Northfield.

THE ST. CROIX & CHIPPEWA RIVER RAILROAD CO.—RIVER FALLS, Wis., June 9.—The St. Croix & Chippewa River Railroad company has been incorporated with a capital stock of $500,000. A charter has been obtained and the following officers elected: I. McGregor, president; J. D. Putnam, vice president; J. B. Thayer, secretary. The road is to be constructed between a point on Lake St. Croix near Catfish bar, by way of this village and a point on the Chippewa River near Duran, to connect with the Chippewa Valley & Superior road.

MILES OF LOADED CARS.—WINNIPEG, June 9.—There are thirteen miles of loaded cars standing on the tracks of the Canadian Pacific Railroad in Winnipeg, St. Boniface and other points between here and including St. Vincent. The local accommodation for removal is insufficient to meet the demand, and the Canadian Pacific have put on a force of 100 men to assist to unload. The freight shed is not only filled but the ground all around is covered with goods.

BONDS VOTED.—Wheeling, W. Va., has voted to subscribe for $30,000 of the stock of the Wheeling, Parkersburg & Charleston Railroad. The road will run from Wheeling to the mouth of the Kanawha.

THE TEXAS & PACIFIC.—MARSHALL, Tex., June 10.—The working forces of the Texas & Pacific car and machine shops here have been augmented recently, until the number now employed exceeds the forces engaged prior to the reduction. As several damaged cars and other jobs have been forwarded to St. Louis lately, on account of pressure of work at the Marshall shops, it is thought there will be a further increase here, that all such work may be done at home.

TEXAS NARROW GAUGE.—On the 10th connection was made between the tracks of Bremond's Houston, East & West Texas Railway and Col. Fred Grant's Texas Western, the rail being united at the new bridge just completed over Buffalo Bayou. Both are narrow-gauge roads.

LABOR ON A LOCOMOTIVE.—From the statistics of the locomotive industry it appears that it takes five men about one year to construct a locomotive at the present time. In 1835, the date at which the industry really assumed a standing in this country, at about which time the Baldwin Locomotive Works and the locomotive establishment at Paterson, N. J., commenced business, it took more than double that number of hands the space of eighteen months to make an engine. The difference in time and labor saved must be looked for in the improvement of the old machinery and the invention of new machinery and appliances.—*Mechanic.*

NEW LUMBER LINE.—A Milwaukee note says: President Rhinelander and General Manager Reed, of the Milwaukee, Lake Shore & Western road, left for Pelican, the northern terminus of the line, yesterday. They will look over the projected routes to the Wisconsin River rapids, from a point a few miles above Pelican, and will definitely decide upon the exact direction of the new line. It is the intention of the officials to engage large gangs of graders and tracklayers and rush the construction of the branch to completion before the middle of next August, in order to compete for the Northern fall lumber traffic.

A NEW ROAD.—Two corps of engineers left here last night for Springfield, Mo., to survey a road from Springfield to Harrison, Ark., a distance of one hundred miles. This road is being constructed by the St. Louis & San Francisco line, and will open a rich agricultural and mineral country in Central and Northern Arkansas. It will be pressed to completion as rapidly as the road can be graded. It is proposed to extend it to Yellville, Ark., and thence southeast to the interior of Arkansas. The road is built as a feeder to the 'Frisco line, and to draw the trade of Arkansas to St. Louis.—*St. Louis Exchange, June 8.*

THE Pittsburgh Southern Railroad has been sold to the Pittsburgh & Monongahela Valley Railroad.

A PENNSYLVANIA ROAD.—Work on the new Delaware Valley Railroad will begin in August if the right of way between Milford and Port Jarvis can be secured by that time.

THE Canadian Pacific Railway is now graded for 150 miles west of Brandon, and ironed for 80 miles. Word has been received from the Barclay and Brereton survey parties that the former has completed correction of the survey of last year, and the line has now been definitely located further south. The new line will save ten miles of construction, besides being straighter and easier of operation. It will be more expensive to build, but there will be a saving in the end. The route as now located follows the line between townships 17 and 18, almost from the center of range 11, west of the second principal meridian to the east line of range 21, crossing Pile of Bones Creek, where the north line of township 17 intersects that line. The route is now fully fixed to Moose Jaw Creek with this correction. Brereton is now about locating the line from Moose Jaw to Strong Current Creek and ferry, and Shaw from there to the Rockies.

GETTING TO BE GIGANTIC.—The East Tennessee, Virginia & Georgia road will soon have its extension from Macon, via Atlanta, to Rome, Ga., completed. That portion of the extension from Macon to Atlanta will be completed by the 15th of July, while the Rome extension will be ready for use as early as the 1st of September. When these extensions are completed they will become formidable competitors with the Georgia Central and Western & Atlantic roads. The latter named railroad is owned by the State, but operated under lease to private parties. For years it has been one of the best paying roads in the South, but its great monopoly will soon be at an end. The present lease has some seven or eight years yet to run, but at the expiration of that time it will be a difficult thing to lease it for anything like the sum now realized. It is believed that the State would now be willing to sell the road if anything like a reasonable offer was made. In view of the growing opposition, it is doubtful if any syndicate can be found that would care to purchase.

RAILROAD WORK.—Work on the Milwaukee & Lake Winnebago Railroad is being pushed forward as rapidly as possible. The route between Neenah and Oshkosh has been surveyed and staked out.

PROGRESS IN CANADA.—The surveyors are pushing forward work on the Quebec & Ontario Railway. They are now at work staking the proposed line near Doncaster, and are steadily working westward. Work on the first division, commencing at the Yorkville terminus, will be commenced shortly. The first division covers forty miles of the proposed road.

TUNNELS.

THE MONT BLANC TUNNEL.—Engineers are said to believe the proposed Mont Blanc tunnel to be impracticable. Dr. Stapf, of the St. Gothard work, is one of them. He has recently announced himself in accord with Herr Heins, a Swiss engineer, in pronouncing the work one of immense difficulty, since in one part it would need to be carried through a formation of anhydrous gypsum, which, on exposure to the air, expands beyond control. Herr Heins says, in addition, the minimum temperature of the galleries would be 86° Fahr.

CONTRACTS LET.

SCHOOL-HOUSE CONTRACT LET.—The Committee of City Property, of Holyoke, Mass., has awarded the contract for the construction of the ward 7 school-house to James Dougherty for $18,990. There were five bids, Mr. Dougherty's being the lowest. The committee rejected the bids for the excavating as too high, and will have the work done by the city teams and men, who will begin at once. The award is $700 less than the architect's estimates. The contract calls for the completion of the building within five months.

RAILROAD CONTRACTS LET.—The contracts for clearing and grubbing 75 miles of the Ottawa & Gatineau Valley Railway, from Hull to Desert, have been awarded. Messrs. Grace and Fitzgerald take the upper half, and Messrs. Bainbridge (Pickanock) and T. F. Delanay (Napanee) the lower half. Work is to be commenced at once, and to be completed by the 1st of September.

PUMPING ENGINE CONTRACT LET. — The St. Louis office of Henry R. Worthington (F. H. Pond, representative) have contracted to furnish the pumping machinery for the Hot Springs (Ark.) Water-Works, consisting of two pumping engines, having a combined capacity of 1,500,000 gallons per day, together with the boilers, etc.

The contract to build the combination bridge, two spans, 110 ft. each, stone piers, at Hamburg, Ia., was awarded to S. M. Hewett, of that place.

The contract to build the iron bridge at Anamosa, Ia., two spans, 112 feet each, stone piers, was awarded to King Bridge Co., of Des Moines, Ia.

The contract to build an iron bridge, 112 ft., stone piers, at Savannah, Mo., was awarded to W. J. Hobson.

BRIDGE CONTRACT LET.—Proposals were opened June 15, for the construction of the superstructure of an iron bridge on Chapel street over West River, at New Haven, Conn., with the following result:

Clarke Bridge Company, Baltimore, Md..........	$11,053.00
King Iron Bridge Company, Cleveland, Ohio.......	9,150.00
L. W. Densmore, Hillsboro Centre, N. H.........	9,068.00
Wallis Iron Works, Jersey City, N. J............	8,945.00
Whitbeck & Power, Hudson, N. Y	8,848.00
Wrought Iron Bridge Company, Canton, Ohio...	8,560.00
D. H. Andrews, Boston, Mass	8,150.00
C. V. Pendleton, Norwich, Conn	7,844.00
Morse Bridge Company, Youngstown, Ohio.......	7,500.00
Corrugated Metal Company, East Berlin, Conn....	6,990 00

The contract was awarded to the Corrugated Metal Company. Proposals for the substructure will soon be called for.

MILWAUKEE CONTRACT LET.—The following contracts were awarded by the Board of Public Works, yesterday: Laying pipe sewer in Walnut street from Nineteenth to Twentieth street, to Robert Chambers at $1.69 per lineal foot; to the same contractor for laying a pipe sewer in Beaubian street from Eleventh to Twelfth street at $1.54 per foot; for paving Galena street from Third to Seventh streets, William Forrestal, at $1.22 per square yard; for curbing in the same street, V. Kuhlman, at 56¼ cents per lineal foot; for planking the sidewalk, H. Vogt, at 38 cents per foot; for sodding, M. Shea, at 12 cents per square yard.

CAR WHEEL CONTRACT LET.—The Chicago, Milwaukee & St. Paul Railway Company has completed a contract with the Allen Paper Car Wheel Company, of New York, for a supply of wheels for all its parlor, sleeping and dining-room coaches. It is the intention to introduce these wheels generally upon the road outside of freight cars.

BUILDING CONTRACT LET.—The committee on works of the Trustees of the Gas Works met in the Gas Office yesterday to receive proposals for furnishing the material and building the alterations of the coal storehouse and wall around the tank yard, 600 feet in length. Samuel Hart was the successful bidder, at $8,300.—*Philadelphia Times, June 13.*

BUILDINGS.

PLANS FOR COUNTY BUILDINGS.—WASHINGTON, C.H., O., June 10.—The Commissioners adopted the plan of Gibbs & Co., architects, of Toledo, O., for the new court-house and jail in this county. The court-house will cost $85,000 and the jail $15,000.

BUILDING IN THIS CITY.—José F. Navarro transmitted to the Building Bureau plans for eight new fire-proof flat houses, which he proposes to build on Fifty-eighth and Fifty-ninth streets, near Seventh avenue. The flats are to be nine stories high, with a total frontage of 420 ft. and 200 ft. in depth, with court-yards. The materials are to be brick and stone, with slate and brick roofing. The estimated cost is $200,000 each.

COURT-HOUSE AT LOS ANGELES, CAL.—The County Board of Supervisors have voted to sell the present court house and devote the proceeds toward building a new one.

BRIDGES.

WILL BUILD A BRIDGE.—Duxbury, Mass., will build a stone bridge over Blue Fish River. The building committee consists of John S. Loring, Bradford Weston and Andrew Northey.

BIDS FOR ERECTING A BRIDGE AT SALISBURY.—NEWBURYPORT, Mass., June 12.—The County Commissioners have opened the bids for the mason work of Deer Island Bridge, in Salisbury, which varied from $84,000, the lowest (by Ross & Blaisdell, of Ipswich,) to the highest, $127,000 (by J. A. Greeley, of Newburyport).

NEW IRON BRIDGE.—Work commences next week on an $1,800 new iron bridge just east of Tekonsha, Mich.

MISCELLANEOUS.

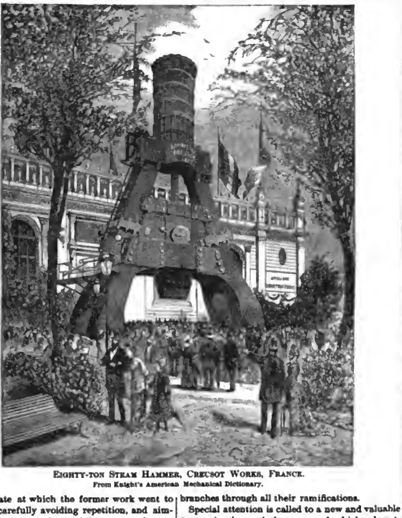
CONGRESSIONAL NOTE.—Mr. Beach introduced a bill granting permission to three men, therein named, to dig for treasure and minerals on the government lands at West Point, one-quarter of the treasure found to belong to the government; also a bill authorizing the construction of a bridge across the Hudson River between Storm King and Breakneck mountains.

RESUMED WORK.—The iron mills in Cincinnati, Newport, Covington and Aurora have all resumed operations.

A NEW MECHANICAL DICTIONARY.

Since the compilation of Knight's American Mechanical Dictionary, in 1877, the progress made in the development of the mechanical arts is unprecedented in the history of the world. Not only in such striking and wonderful achievements as relate to the telephone, phonograph and electric light, toward which popular attention is naturally drawn, but in every department of applied mechanics, there has been developed a fertility of resource in the adaptation of means to ends quite as marvelous and equally important in practical results. Achievement has outrun the most sanguine expectation, and with such rapidity that even the most recent records are found to be very deficient in supplying the special information most desired.

The hearty approval which Knight's American Mechanical Dictionary has received in all parts of the world has encouraged the publishers to issue an entirely new volume, thus continuing the record from the date at which the former work went to press, but carefully avoiding repetition, and aiming to furnish not only a satisfactory supplement to the original work, but a book which shall have an individual and separate value as a complete record of half a decade in the history of invention. From this fact it is evident that this volume forms an indispensable supplement to all works of reference upon mechanics now extant, as none of them cover the period mentioned.



Eighty-ton Steam Hammer, Creusot Works, France.
From Knight's American Mechanical Dictionary.

The same method has been adopted in dealing with the subject matter in both works. First, each article appears in its proper alphabetical place, thus fulfilling the function of a dictionary, in affording direct response to inquiry. Second, the items of information thus distributed throughout the work are classified in special indexes of the art, profession, or manufacture to which they pertain. The book thus fulfills the function of a cyclopedia, which is a collection of treatises.

The value of a work of reference depends largely upon its index. When one has a question to ask of an ordinary cyclopædia it is frequently very difficult to determine under which title or heading to look.

The author has invented a system of what he terms "specific indexes," by the use of which the inquirer is guided straight to the information he is in quest of, even though he be entirely ignorant of the name of a thing, and have but the most vague and general notion of its use. This is accomplished by grouping under the general title of each science, art, trade or profession a list or "specific index" of every article in the book bearing any relation to the subject in question. The titles of these indexes are in turn grouped at the beginning of the book, so that by a glance one may determine which clew to follow.

Beside the use above mentioned, these specific indexes afford the reader an excellent opportunity for investigating thoroughly all that pertains directly or indirectly to any special subject, by using the index under the title of that subject as a sort of head-center, and following out its various branches through all their ramifications.

Special attention is called to a new and valuable feature in the work, by means of which exhaustive information on any subject is placed within easy reach. The author has made a complete index to technical literature, covering a period of five years, and embracing all English and American technical journals published from 1876 to 1880 inclusive. Under title of each subject may be found a complete list of every article which has appeared, during this period, in the columns of these periodicals, and as every subject of importance has been thoroughly discussed therein, it is evident that the whole range of recent investigation is thus placed at easy command. This index cannot fail to meet with the heartiest appreciation among those who have experienced the labor and difficulty attending an exhaustive search upon any line of inquiry.

> "Index-learning turns no student pale,
> Yet holds the eel of science by the tail."

The work treats of many thousand subjects, and is illustrated with over 2,500 carefully prepared engravings and numerous full-page plates, and for general typographical excellence, quality of paper and printing, it is unsurpassed. It may be bound uniform with any edition of the Knight's American Mechanical Dictionary, or with any cyclopædia or other book of reference of the usual size and shape. Sold only by subscription in four sections, containing 240 pages each.

For further particulars address the publishers, Houghton, Mifflin & Co., Boston, Mass.

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PUBLIC IMPROVEMENTS AT MINNEAPOLIS.

For the purpose of learning something in regard to the progress of work upon a few of the public improvements proposed in Minneapolis, a reporter of the *Pioneer-Press* called yesterday morning upon Superintendent Johnson, of the Water-Works, and City Engineer Rinker for the desired facts in their respective departments, and in response to inquiries the following interesting information was courteously furnished.

New Water Mains.—Superintendent Johnson stated that among the new water mains just completed or approaching completion, and concerning which but little has been said in the papers, was one on University avenue, extending from Third to Thirteenth avenues southeast, a distance of ten full blocks. Another important main is being laid on Fifth avenue southeast, from Seventh to Division streets, so as to afford fire protection to the mills and manufactories which have recently sprung into existence upon and in the vicinity of the last-mentioned thoroughfare. A 12-in. pipe is also being laid on University avenue north, necessitating blasting through 5 ft. of limestone for a considerable portion of the distance covered by this branch of the water supply system. This pipe will be laid three full blocks, and was completed for two-thirds of the distance last evening. Numerous other connections will probably be made during the season under the direction of the Board of Water-Works Commissioners, but no data was obtainable showing the probable disbursements of the summer for the amount of the water mains and pipes.

At the Pump House.—The new tunnel for the water-works has been completed, and a substantial retaining wall constructed for a distance of 250 ft. from the north end. Fair progress is being made in the construction of the new addition to the pump house, more commonly known as the "pump house extension," which is expected to add to the efficiency of the works in providing an ample and reliable supply of water at all times—the old pump house having failed to meet the demands of rapidly increasing population. Twelve thousand feet of new pipe are now being laid at the rate of one block per day.

City Engineer's Department.—The department under the capable supervision of City Engineer Rinker is crowded with business just now—bridge building, street improvements, paving, sewers and various other important matters being intrusted almost exclusively to him. Owing to the manifold duties devolving upon him, he has been compelled to place one of his assistants, Mr. J. E. Snyder, in charge of the street work proper, and there are at present 80,000 cu. yds. of street excavation under contract, and fully as much more will be advertised for, which is twice as much in that particular direction as has ever been done in the city at any one time. During the summer between $40,000 and $50,000 will be expended in grading and clearing the streets of the city, under the most economical disbursements of the fund under his control.

Sewer Work.—One of the most important duties intrusted to Mr. Rinker is the extension of the sewer system, on account of its direct effects upon the public health and convenience. Owing to the fact that all the bids for the sewer extensions thus far received have been exorbitantly high, the common council has authorized Mr. Rinker to employ men by the day in this branch of the service, and to reject all bids. Under the authority thus conferred the city engineer on Wednesday began operations on the Eleventh avenue south sewer, which will be two miles in length, extending from the Mississippi river up Eleventh avenue for some distance, and from thence to Hennepin avenue, the total cost of this one refuse carrier alone being estimated at about $90,000. Machinery will be utilized in the construction of the above and other sewers authorized by the council, and the total expenditure for extensions of the sewer system during the season will be from $150,000 to $175,000, but the large sum cannot be expended for a better purpose.

The above partial exhibit of the operations and disbursements of two of the public departments is sufficient to show the extent and cost of the improvements now commenced or authorized, but which are imperatively demanded to keep pace with the general advancement of the city of Minneapolis.—*Pioneer-Press*, June 17.

WAVER POWER.

La Nature, of Paris, gives an account of an apparatus, designed by M. Ganchez, for utilizing the force of waves, and consisting essentially of a float, weighing from 35 to 95 tons, which is connected with a bell-shaped compressor by ropes or chains passing over pulleys. The float is submerged and rises and falls with the waves. When it falls it raises the bell, which has previously been below the water level, and as it empties itself of water the air rushes into it through openings in the top. As the float rises again the bell sinks, the water rises in it and compresses the air, driving it out into pipes which conduct it to reservoirs on shore, whence it can be distributed as required.

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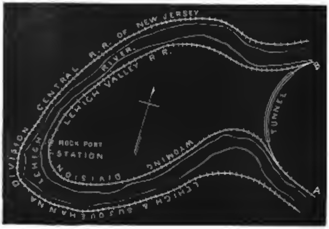
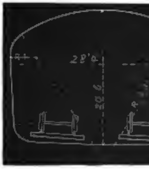
THE ROCKPORT TUNNEL.

The accompanying map (Fig. 1) shows the present location of the Lehigh Valley Railroad and of the proposed tunnel, for constructing which a contract has just been awarded to Mr. John Donoghen, of Emmittsburg, Md. The tunnel will be about 1,200 ft. long and will be excavated through rock the entire distance. The estimated amount of excavation in the tunnel is 22,000 cubic yards, and in the approaches 40,000 cubic yards of earth, 20,000 cubic yards of loose stone and 10,000 cubic yards of solid rock. Work will be commenced at an early day. Fig. 2 is a cross-section of the tunnel, which will be 20.5 ft. from bottom to top of arch and 28 ft. 4 in. wide at the spring points. The company will save by the tunnel 7,311 ft. of road and 333° 18' of curvature in curves of from 2° to 11°.



MAP.



CROSS SECTION,

THE BROCKPORT TUNNEL.

Curvature: old line, A to B, 463.°06; new line, A to B, 129.°48; saved, A to B, 333.°18. Distance: old line, A to B, 9700 ft.; new line, A to B, 2389 ft.; saved, A to B, 7311 ft.

The Superintendent and Chief Engineer is Mr. Robt. H. Sayre, whose headquarters is at Bethlehem, Pa.

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ABANDONMENT OF STEAM TRAMWAYS IN PARIS.—The Paris Tramway Company wished to give steam a thorough trial, and as they have had five years' experience of it, and have tried every system they could find—the number was no less than 21—they have every reason to consider that their acquaintance with the merits and defects of steam power is pretty exhaustive. The end has been that they have totally abandoned steam and reverted to the old system of employing horses. The result of the prolonged trials has been to show that steam is dearer than horse-power. The engine requires a driver and a stoker, whose pay is greater than two of the old drivers or coachmen. Then the fuel and maintenance of the engines in order were costly, while the original outlay in capital is about the same as that required to keep up the requisite stud of horses. Moreover, hardly a week, often a day in the week, passed without some accident on the steam line, which proved very costly to the company, and led to complaints being addressed from various quarters to the authorities. Hence, the authorities at last issued a prohibition against the employment of steam, and in this the company acquiesced with perfect readiness.

CORRESPONDENCE.

THE STANDARD WATER METER.

NEW YORK, June 15, 1882.

EDITOR ENGINEERING NEWS:

We take pleasure in acknowledging the merits of your editorial on water meters in ENGINEERING NEWS of June 10, 1882, and it has been our privilege to read your valuable paper the past two years, and particularly valuable on account of the full and elaborate "History and Statistics of American Water-Works." One of the reasons why water meters are not looked on with more favor is on account of there being so many put on the market without merit in themselves and which have brought ridicule on a necessity now felt over the entire country; for it is not a question of revenue to the water departments, nor of wastage, but yet a question more vital. Where is the water to come from if something is not done to prevent this increasing habit of waste? Were it not that the water meter business had not been used so much as a stock speculation and the real motive of the companies lost sight of (that is, to manufacture and sell water meters), every good company would have been benefited by the introduction of fifty good meters of different styles instead of so few representative ones, and every responsible meter company can but appreciate any work to purify the business and bring to the front real worth. While we are willing to accord to the Worthington, Union and Crown their places as representative meters, yet we claim to be classed with them, for we have met with good success introducing the Standard Water Meter into a number of cities in the country, and can show as many and good testimonials for merit and endurance as any of the others, and while we have no shop of our own at present we contract them out with one of the largest manufacturers in the country, who can verify our statements. You are doing a noble work to your fellows when you try to educate them to save what is generally considered worthless and what is so priceless.

Yours truly,
HENRY C. FOLGER, Sec'y.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page 199.*)

CCCXXXVII.—STAUNTON.

Staunton, Virginia, in lat. 38° 10' N., long. 79° 1' W., is on an elevated plateau in the Blue Ridge, about 1,450 ft. above the sea level. The site slopes to N. E. and S. E. at the rate of about 25 ft. to the mile. Settled before 1738, it was incorporated as a city in 1871. Water-works were built by the city in 1875, after plans of Donald Allen, taking the supply from 10 springs issuing from the limestone rock. The water is collected by stoneware pipes of from 4 to 16-in. diameter laid in cement. About 2 miles of pipe are used. The collected water is pumped by a Worthington compound duplex engine, 176 ft. into a reservoir 210 ft. in diameter at top and 18 ft. deep, built in excavation and embankment, puddled and lined with gravel, with its surface 215 ft. above the city.

Distribution is by 5 miles of cast-iron pipes of from 12 to 3-in. diameter, with 82 fire hydrants, 35 gates and 5 meters. The number of taps is not known. Service pipes are of wrought iron.

The population in 1880 was 7,767, and the daily consumption 500,000 gallons.

The works have cost $100,000. The bonded debt is $80,000, at 8 per cent. interest. The expenses in 1881 were $4,000 and the receipts $9,000.

The works are under the control of the City Council.

E. W. Harman is the Superintendent.

CCCXXXVIII.—TRURO.

Truro, in Nova Scotia, in lat. 45° 30' N., long. 63° 30' W., at the mouth of Salmon River, near the head of Cobiquid Bay, is on level ground between Cobiquid Mountain and a hill which rises back of the town. Settled in 1760, it was incorporated as a city in 1875, in which year water-works were built by the town under the superintendence of W. H. Tremain, C. E. The supply for domestic use is taken from a small stream about 35 ft. above the town and 50 ft. above the pumps, which are placed so as to take a supply for fire purposes from the Salmon River. For the domestic supply the water of the brook, filtered through brush and gravel with not very satisfactory results, is conveyed directly into the mains. For fire service two rotary pumps driven by two 25 horse-power steam engines pump directly into the mains. The machinery was furnished by the Waterous Engine Works. Steam can be raised and fire pressure of 90 to 115 lbs. put on the mains in from 9 to 12 minutes' notice.

Distribution is by 4 miles of cast-iron pipe of 8 to 4-in. diameter, with 32 fire hydrants, 12 gates and 108 taps. Service pipes are mainly of wrought iron coated, and some lead pipe.

The population in 1880 was 4,000. The consumption is not known.

The works have cost $30,000, which is the amount of the bonded debt at 6 per cent. interest.

The expenses in 1881 were $900, and the receipts $500.

The works are managed by a committee consisting of the Mayor and three members of the Town Council. Alexander L. Archibald is the Engineer and Superintendent.

CCCXXXIX—COLUMBUS, MISS.

Columbus, Mississippi, in lat 33° 28' N., long. 80° 25' W., is on the Tombigbee River, on the east bank of which the ground is rolling, and on the west level. It was settled in 1819.

Water-works were built by the city in 1867, taking the supply from an artesian well of 4-in. bore which discharges 150,000 gallons per day, 10 ft. above the surface of the ground. The water is lifted 110 ft. by a Knowles pump into a brick reservoir 20 ft. in diameter and 25 ft. high.; whence it is distributed by 1¼ miles of 6-in. cast-iron pipe, with 18 fire-hydrants. The number of taps is not given. The population in 1880 was 5,350. The daily consumption varies from 10,000 gallons in winter to 50,000 gallons in summer.

The works have cost about $3,000. No further financial statements are given.

M. A. Hale is the Superintendent.

CCCXL.—SAN DIEGO.

San Diego, California, in lat. 32° 41' N., long. 117° 13' W., is on San Diego Bay. The surrounding country is hilly.

The site was first occupied in 1769 by a Jesuit Mission. The present city was founded in 1830, and incorporated in 1850.

Water-works were built by a private company in 1873 after plans of H. M. Covert, taking the supply from the San Diego River, which drains 40 square miles, and pumping it 220 ft. by a Hooker steam pump of 8-in. bore and 42-in. stroke, into two reservoirs, one holding 100,000 gallons 100 ft. above the town, the other holding 850,000 gallons 200 ft. above the town.

Distribution is by 6 miles of 5-in. riveted wrought-iron pipe, asphalted. The pipe is made of No. 14 sheet iron. There are 5 fire hydrants, 11 gates and 300 taps, and 51 meters. The town does not pay for use of hydrants. Service pipes are of wrought iron, coated.

The population in 1880 was 2,700. The daily consumption is 80,000 gallons.

The capital stock of the company is $250,000. The works have cost $79,000. There is no debt.

The expenses in 1881 were $14,828,08, and the receipts $17,975,57.

E. J. Buell is the Superintendent.

CCCXLI—SANTA BARBARA.

Santa Barbara, California, in lat. 34° 26′ N., long. 119° 43′ W., is at the southeast end of a valley 2 miles wide and 5 miles long between a range of hills along the Pacific coast and the Santa Inez range of mountains. Missouri Creek, a stream of ten square miles water-shed, in which the water runs only during the rainy season, passes through the city.

Settled by the Jesuit missionaries about 1780, it was incorporated as a city in 1874.

A reservoir was constructed by the Franciscan monks about 50 years ago, by a stone dam laid in cement, across Mission Creek, 100 ft. long, 16 ft. thick and 16 ft. high, with both sides vertical. From this basin the water was conveyed 10,000 ft. by an open conduit lined with stone and cemented, to a reservoir 110 ft. square and 10 ft. deep. The walls of cemented stone are vertical on the inner face, 15 ft. thick for 4 ft. from the bottom and 8 ft. thick at top. Its surface is 300 ft. above the city.

In 1873 the conduit being much obstructed by breaks from land slides and growth of roots, a wooden flume, V-shaped, with sides 12 in. wide, and laid on a grade of 2½ ft. per 100, was substituted, and distributing pipes were laid in the city, after plans of Hermann Schuessler, C. E., and under the superintendence of R. B. & A. W. Canfield. The pipes were of No. 16 wrought iron, with riveted joints, and coated with asphalt and coal tar. In the business part of the town, where the pressure at night frequently was over 90 lbs., the riveted pipe leaked greatly and has been replaced by cast-iron pipe. There are 4½ miles of pipe, of from 6 to 2-in. diameter. The 6-in. and 5-in. are of wrought iron, riveted, the 4-in. of cast iron and the 3-in. and 2-in. and some 4-in. of wrought iron, welded. There are 14 fire hydrants, 19 gates and 220 taps. Service pipes are of iron, some galvanized and some coated with asphalt and tar.

The population in 1880 was 3,600, and the daily consumption 180,000 gallons.

The works are owned by a private company, with a capital stock of $120,000. They have cost $30,586, besides $20,000 paid for the old works. The gross receipts to December, 1881, have been $55,548.20. There is no debt. Further financial statements are not furnished. R. B. Canfield is the President, and A. W. Canfield the Secretary and Superintendent.

CCCXLII.—LANCASTER, O.

Lancaster, Ohio, in lat. 39° 42′ N., long. 88° 35′ W., is on the Hock Hocking River. The ground rises from the river and the Hocking canal to a hill 263 ft. above the canal.

Settled in 1800 and then called New Lancaster, the prefix was dropped in 1805.

Water-works were built by the city in 1877, after plans of A. Bauman. The first works were for fire protection only and consisted of a small pumping engine and a single line of pipe, taking water from the Hocking canal. In 1878 a stand-pipe 18 ft. in diameter and 69 ft. high was erected. In 1880 the boiler proving too small, steam was brought 200 ft. to the engine from an iron works. Permanent works were then built. A well 20 ft. in diameter and 16 ft. deep, sunk in water-bearing gravel, receives the water from a gallery 270 ft. long, which is built of brick, is 4 ft. wide and 4½ ft. high, arched at top and taking its water from the bottom. It is to be made 500 ft. long. The water now rises to the surface of the ground and wastes over the top of the well.

A Worthington pumping engine with 20-in. steam and 12-in. water cylinder of 15 in. stroke, lifts the water 133 ft. into the stand-pipe which is on ground 61 ft. above the pump.

The construction of a reservoir on Pleasant Hill, 263 ft. above the city is contemplated.

Distribution is by 6 miles of cast-iron pipe of from 12 to 4-in. diameter, with 61 fire hydrants, 25 gates and 100 taps. Service pipes are of lead.

The population in 1880 was 8,000. The daily consumption is not known.

The works have cost $46,801.46 to March 20, 1882, for construction, and $2,397.60 for operating.

The bonded debt is $25,000.

The expenses in 1881 were $1,854.58, and the receipts, $1,196.55.

The works are managed by three Trustees. A. Bauman is the Secretary and Superintendent.

CCCXLIII—MALDEN.

Malden, Massachusetts, in lat. 42° 25′ N., long. 71° 8′ W., on Malden River, a stream tributary to the Mystic River, is on level ground in the southerly part of the town and hilly to the northward. It was settled in 1634.

Water-works were built for the town in 1870 by G. H. Norman after plans of A. F. Sargent, C. E., taking the supply from Spot Pond, which also supplies Medford and Melrose. It has a water-shed of about 2 square miles and an area of 296 acres at 139 ft. above tide water. The supply is by gravity.

The distribution is by 36.8 miles of wrought-iron and cement pipe, of from 16 to 4-in. diameter, with 196 fire hydrants, 317 gates and 2,468 taps. There are 29 meters in use. The town pays $3,000 per annum for public hydrants and drinking fountains. Lead service pipes are used.

The distributing pipes are made by the water board, which is found to cost about 25 per cent. less and to insure better pipe than purchasing from manufacturers. Prior to 1875 considerable trouble was had with the freezing of pipes. In that year more than a mile of main was frozen at one time and thawed out by use of steam. Since then pipes have been laid deeper. The population in 1880 was 12,017, and the daily consumption 480,000 gallons.

The cost of the works has been as follows, to December 31, 1881: For construction, $862,101.53; for maintenance, $69,513.49; for interest, $198,092.79. The receipts have been $290,883.09. The bonded debt is $350,000, at 6 per cent. The expenses in 1881 were: For extensions, $6,792.05; for maintenance, $4,325.66, and for interest, $21,000. The receipts were $34,801.11.

The works are managed by three commissioners, one being elected each year. W. W. Hawkes is the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From W. W. Hawkes, Superintendent, statistics and water-works of Malden, Mass., and full set of reports from 1873 to 1881. From A. Bauman, Secretary, statistics and report of the water-works of Lancaster, O. From R. B. Canfield, President Mission Water Co., statistics and water rates of the water-works of Santa Barbara, Cal. From E. J. Buell, Secretary and Superintendent, statistics and water rates of the water-works of San Diego, Cal. From Alexander L. Archibald, Engineer, report and statistics and water rates of the water-works of Truro, Nova Scotia. From M. A. Hale, statistics of the water-works of Columbus, Miss. From E. W. Harman, Superintendent, reports, statistics and water rates of the water-works of Staunton, Va.

BAR OF RIO GRANDE.

From *The Rio News* of Rio de Janeiro, Brazil, we clip the following:

For many years past there has been considerable conflict of opinion as to the cause of the bar at the entrance to the port of Rio Grande. The prevailing idea, however, has hitherto been that the silt and alluvial matter brought down by the water from the interior was deposited at the entrance of the estuary and formed the bar. This notion has been so elaborated that calculations have been put forward of the actual quantity in cubic meters of sand which have been thus deposited. But a careful examination of what actually takes place during the prevalence of northeast and east winds clearly shows that this supposed deposit from the upland waters does not now take place to any appreciable extent, and hence is insufficient to account for the present state of the bar.

Another theory for the formation of the bar is that it results from the meeting of the fresh water and the northeast swell. The concussion produced is presumed to cause the suspended earthy matter to fall to the bottom. A third theory is that the action of the southwest swell has been such as to drive the sand towards the entrance and thus cut off the scouring action of the outflowing current.

It is possible that a combination of these influences has considerably increased the tendency to forms and banks at or near the present bar, but close observation shows that its present state is entirely due to the breaking of the ocean waves on the shallow bottom. During the prevalence of the east and northeast winds the sand-banks are surrounded by a heavy surf. Every broken wave tears up sand from the bottom. This sand is carried forward by the water, and is eventually deposited by the total dispersion of the wave. The sand thus deposited forms in course of time a shoal on which in turn more waves break, and it assumes under their action a ridge with deeper water on either side. Now this action, under which the bar was in a state of continuous though possibly very slow growth, would not be prevented by any increase of velocity or scouring action of the outflowing current. It is true that in favorable seasons and strong gales from the west and northwest some counter action would be set up, and the outflowing current would remove a part of the recent deposit; but the first gale from the east and northeast would re-establish the conditions and the ridge would be reformed higher and broader than before. That this is the case at the bar of Rio Grande is demonstrated beyond question by the experience of the last ten months.

The only remedy for this action of the ocean wave is by dividing this belt of surf and compelling it to break at a distance from the entrance to the navigable channel; or, in other words, to construct some artificial obstruction so as to prevent the waves of translation from acting upon the bar, when the sand now forming it is removed either by dredging or any other mechanical agency. But it must be borne in mind that no amount of dredging applied in the present state of the bar can be of the slightest avail, because the conditions necessary to secure success do not exist. It must also be distinctly understood that a breakwater will not remove the present bar, but it will prevent the formation of another when the present one is removed, and it will enable the outflowing current to keep the navigable channel open by facilitating the scour into deep water.

It is believed that the great error which has hitherto been committed in dealing with the harbor of Rio Grande has been the constant interference with the bed of the estuary inside the bar, while no attention was paid to the formation of the bar itself. Dredging has been carried on at intervals inside the entrance and this has formed so many holes or hollows by which the declivity of the channel has been altered and the uniform scouring action of the outflowing currents interfered with if not partially destroyed, for it is obvious that all scouring action must be due to the lower stratum of water and not to the surface currents. Soundings recently taken show that the bed of the present channel is higher at its entrance from the sea than at the anchorage opposite Sao José do Norte, clearly proving the cause of the retardation of the scour. All observations tend to confirm the opinion that any permanent and effective improvement to the harbor must commence outside the entrance.

The grand obstacle to these improvements, and more especially the construction of breakwaters, is the probable expense. The estimate presented by Sir John Hawkshaw in 1875 put the cost of efficient, permanent breakwaters for the improvements at Rio Grande at £2,000,000 sterling. If such an outlay were absolutely necessary, than it is questionable if such works are possible; but on the other hand it may be asked if it is not practicable to construct an efficient breakwater at a much less cost. The experience of other similar works shows that breakwaters have been erected in very exposed situations which have proved effective, the costs of which were scarcely a sixth of that stated by Sir John Hawkshaw. At Rio Grande the absence of all suitable material in the shape of stone, shingle, etc., precludes the idea of having recourse to the modern system of concrete blocks, or large masses of stone; but the province to the north of Porto Alegere would furnish an abundant supply of excellent timber as well as any quantity of rubble stone. With these a breakwater could be constructed which would insure immediate means for improving the entrance to the harbor.

The use of timber may be objected to as not being sufficiently durable, but if an effective breakwater could be constructed to last say 50 years, it is to be expected that long before that time the immense advantages which would accrue to the port, would furnish ample resources to maintain such a structure or on the same site gradually to construct one of more durable material. The urgency of the case is such that any means should be resorted to that would insure a speedy removal of the present obstructions; and objections on the score of durability should not weigh against the certain ruin of the trade of Rio Grande, if not of the whole of the south of the province, by delay.

It is confidently believed that with an expenditure of £300,000 the necessary works could be carried out, including the eastern breakwater and the removal of the present bar by a special system of dredging, and that a permanent channel could be opened for vessels drawing 12 ft. 6 in. at all seasons of the year.

Designs have been prepared for a breakwater combining some novel features in the adaptation of piled structures to sandy bottoms. But before presenting these plans to the authorities, the author of them suggests that they should be submitted to the best authorities on harbor engineering for revision, so as to avoid as far as possible the expenditure of money upon mere empirical schemes.

ENGINEERING NEWS

AND

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GEO. H. FROST......EDITOR AND PROPRIETOR.

S. D. V. BURR.............ASSOCIATE EDITOR.

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Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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THE Federation of Contracters, of Belgium, held a meeting on May 24. A resolution was passed authorizing the publication of a journal to be entitled *La Construction*, organ of the Federation, to be under the menagement of M. Andre Hertogs, President of the Federation. Also that the officers of the Federation be charged with representing it officially in relations with the Government and public departments. Also that lectures be arranged on subjecte interesting to those engaged in the building trades.

"TREATISE ON CEMENT," compiled and arranged by M. Albert Schull, is the name of a neat little twelve-page pamphlet "presented" by the Lawrence Cement Co., 67 William street, N. Y., and designed especially to specify the excellences of "Hoffman" Rosendale cement, manufactured by this company. In the few pages are collected numerous valuable hints upon cement, its use, etc., gathered from personal knowledge, and very largely as is duly acknowledged, from the published works of Gen. Q. A. Gillmore and D. H. Mahan, but which, filling small space and being easily looked over, are convenient and will repay the outlay of the postal cart necessary to obtain it.

THE PROPOSED SAHARAN SEA.—The French Minister of Foreign Affairs, M. de Freycinet, has recommended a special commission for the investigation of the above project. M. Roudaire's scheme—the one under consideration—is to excavate a canal nearly 150 miles long, 82½ ft. deep below the sea level, and 328 ft. wide, to lead the waters of the Mediterranean from the Gulf of Gabes into the empty lake beds known as the *chotts* of Rharsa and Mebrir. The Minister does not consider the expense prohibitory. In favor of the scheme is urged the improvement of the climate in the lake region, the fertilized soil, the barrier against the incursions of nomad tribes, the improvement of the commerce of Algeria and Tunis with the interior, and the formation of a herbor of refuge for French mercantile marine in case of war. The objections are the great evaporation causing excessive saltness of the water, and that the water will stagnate and become pestilential. M. Roudaire, however, thinks that a return current to the Mediterranean might be established at the bottom of the canal, and M. de Lesseps thinks the saltiness will decrease. The Commission, the appointment of which has given much satisfaction, is to inquire into: first, the practical means of forming such a lake; second, the probable consequences of doing so, physical, political, and commercial; third, probable expense, and terms on which the work might be conceded to a private company.

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BOSTON ENGINEERING IMPROVEMENTS.

A few weeks ago we were just on the point of starting by rail for a New England city, when a friend suggested going with him by way of Boston. As Boston is always a very agreeable city to visit, the suggestion was accepted, and at the regular hour we left New York by the famous Bristol, of the Fall River Line. It was the evening after Decoration Day and the boat was crowded, fully four hundred unprovided with staterooms sleeping on the floors or sitting on the lounges all night, and the ventilation of the main saloon was so bad that by nine o'clock, while the noisy band was tooting its loudest notes, the air was as stifling and foul as that of an emigrant steamship steerage. In the outer state rooms the air was fresh and pure. The steamboat route is usually a popular one, but why, one can hardly realize after using it. It is as expensive as by rail, it is more tedious, and necessitates the getting from the boat to the cars at a most aggravatingly early hour in the morning, so that the traveler arrives in Boston in a very tired-out condition to commence the day upon. By the railway one leaves New York at 4:30 p. m., and for $5.75 he is landed in Boston in time to go to bed a little after eleven and get well rested for next day's business. We have made the trip by boat several times, but for comfort of body and purse we think the all-rail route superior to any other.

The Boston hotels are all good, and it is but a question of convenience which to go to. We have got into a habit of going to Young's, because it is immediately adjacent to the City Hall and in the very center of business. It has been a hotel for gentlemen only until recently, a very large addition has been made to it, and it may be considered now a leading Boston hotel. It is on the European plan.

In the offices of the City Engineer and City Surveyor we never noticed so large a force of employés as on this visit. Possibly on account of the rainy day fewer men were engaged in field work, but upon inquiry we found that both departments were very busy with the work on hand. City Engineer Wightman and his talented First Assistant, A. Fteley, were very busy in discussing with numerous aldermanic and others visitors various engineering schemes, but mostly relating to the city water supply, while Assistant Engineer Brackett was "up to his eyes" in meter experiments. By the way, understand that the paper prepared by Messrs. A. Fteley and F. P. Stearns, of the Boston City Engineer's office, entitled, *Description of Some Experiments on the Flow of Water, Made During the Construction of Works for Conveying the Water of Sudbury River to Boston*, and which was read only by title at the Washington Convention, contains some entirely new and very interesting facts in regard to the flow of water, which will give it a prominent place in the literature of the subject as soon as it is printed in the Transactions of the American Society.

The park system of Boston is taking shape with satisfactory rapidity. From the Common, situated in the center of the city, one passes through the Public Gardens and up the broad Commonwealth avenue into the new and extensive Park, reclaimed from the lowlands, and now being transformed into a beautiful pleasure ground by the genius of the landscape gardener and architect. When this is completed, Boston, with its beautiful park-like suburbs in addition to this chain of public parks, may well be proud of them as distinctive features in its attractions.

At work on an immense *wooden* sewer contract in the new park, we witnessed the working of Carson's excavating machinery. Simple, cheap and effective, it handled the excavated material most admirably, taking it in huge buckets from the section in process of excavation, and dumping it directly on the completed sewer in the section following. The excavation was over twenty feet deep, but there were no stops, no throwing up of material by gangs of shovelers to blockade a whole roadway, and to be thrown back when the work was advanced to it. It was all done at once with few men, a minimum of labor, and no fuss. We afterwards saw the same apparatus working in a narrow Boston street without interruption to travel alongside, and in a still more difficult location, laying a sewer in a railway freight yard, without interrupting the passage of the constantly running trains in either direction. It is truly one of the most effective and labor and money-saving engineering appliances that has been offered to contractors for a long time. The city of Boston has bought the right to use it in its city work, and we understand that Mr. Carson, who is in the service of the city, is meeting with great success in introducing it to contractors in other cities.

The improved sewerage works at Dorchester and Moon Island are steadily progressing. The big Leavitt engines are up, housed in with a temporary structure and ready to be set in motion. A large weir has been constructed for testing purposes, and it was intended to commence pumping the sewage into the bay opposite South Boston. But the people of that district got out an injunction, and as it will be two or three years more before the tunnel and the Moon Island works are finished, so will the large investments in machinery already made lie idle for that length of time. The work already completed is very great and the magnitude of the whole scheme can only be realized by personal inspection. With Mr. Wm. Jackson, Assistant Engineer in Charge, we visited the works at Dorchester, and thence going by steam launch to Moon Island saw what was being done there. Half way across is the central tunnel shaft around which a considerable island has been built with the excavated rock. The work, originally let to B. Malone, is now being done by the city, under the superintendence of Malone, Jr., the elder Malone being engaged on a railway contract in Pennsylvania.

The Moon Island contract is being done by J. A. Sylvester and associates. They have a large force of men, two locomotives and a long train of dump cars, besides a steam excavator, busy at work. We met Mr. Sylvester as we were returning, and very naturally inquired about his success with his tide breaker, which we have already illustrated, and which is advertised elsewhere. We learned from him that his tide breakers have been used for the past two years with great success in Piscataqua River, N, H., in removing "Gangway Rock," where the tide flows with a velocity of seven miles per hour; and it need hardly be said that contractors will see its utility when the fact is considered that rock which would have cost to remove without the breakers at least $1.25 per cu. yd., actually cost only 28 cents per cu. yd., and it is said that the United States government would have saved thousands of dollars by the use of one or more tide breakers in Hell Gate for deepening the channel, had this invention been made a few years ago. Contractors contemplating the construction of bridge piers and abutments, or the removal of obstructions in swift currents, will find it to their advantage to investigate the claims made for this invention.

On the suburban trains of the Boston & Albany Railroad is an automatic contrivance for closing the doors of the coaches without the usual slamming. It consists of a small cylinder attached to the top rail of the inside of the door; an arm at one end attached to the car beside the door, has a piston working in the cylinder attached to its other end. When the door is opened this piston compresses the air, the door is allowed to close of itself, which it does gently, surely and leisurely, after the manner of all other good Boston institutions. The relief to one's nerves to be rid of the everlasting slam-banging of coach doors is peculiarly grateful.

THE RAILROAD AND INDUSTRIAL OUTLOOK.

Within two or three weeks several large contracts which were withdrawn from the market last January have been presented to manufacturers and accepted at prices very little different from those presented at that time. Contractors and builders report a perceptible improvement in business, not very marked perhaps, but sufficient under the circumstances to strengthen our hope that the worst has been passed. It is better that the iron and general industrial interests should have endured at this time a six months' check than that production should have galloped ahead at last autumn's limits without regard to diminishing requirements. It is not correct to assert that we are on the eve of a revival, but it is correct to say that greater confidence exists in the future commercial and industrial activity than six months ago. At *that* time it was estimated there were projected in the United States alone 17,600 miles of road; of that mileage some 3,600 are reported built, leaving 14.200 of projected mileage, a considerable portion of which is made up of parts of unfinished lines. The foreign demand for American railway bonds is again improving. Railway prosperity depends to a great extent on the whims of European capital, which for the past few months has been averse to liberal investment. The present improvement in demand is based on the increasing volume of staple products which American producers of wealth can offer in exchange for foreign values. The failure to maintain that volume of exchangeable products led to the restriction in railway activity and to the train of effects dependent on this cause.

Some of this 14,200 stretch of mileage is to be pushed to completion that the finished property may be in a condition to earn some dividends. The manufacturers of rails report a greater readiness to go ahead in railway construction than a few months ago. The railroad antagonisms have been virtually settled, and unfavorable and restrictive and directive railway legislation has been set aside, it is quite safe to say permanently. The trunk lines are looking for transcontinental connections, and combinations of the leading officials of several have very recently visited the far West to promote railroad interests. Immigration is developing Western resources, vast possibilities are being opened up in the far Northwest and the far Southwest.

The agricultural productive capacity is being very rapidly increased, and the new regions now penetrated with trunk and main lines only will soon require lateral connections and branches.

Those who imagine we have reached a stopping place in railroad building are not familiar with the rapidly expanding requirements for traffic and travel on both sides of the Mississippi.

Europe has cheap labor, but America has cheap land, and herein lies the secret of the approaching international struggle for trade which will impart fresh life to railroad building.

It is probable that the labor strikes will be adjusted in a few weeks. Manufacturing interests were taken by surprise at the inauguration of a strike on such an enormous scale. Even now the general trade does not admit the probability of a prolonged period of idleness. Stocks of iron and steel are low in hands of manufacturers and jobbers. The steel manufacturers were obliged to concede the workmen's terms. The iron manufacturers will stubbornly resist, not only the advance in wages, but the authority exercised. The formation of an association for the purpose has been effected on a basis and with a degree of unanimity which presages a stubborn conflict on their part. Over one hundred rolling-mills are idle, with over two thousand furnaces. It is calculated that enough mills are at work to meet pressing requirements of consumers and free manufacturers from the necessity of concession.

The threatened scarcity, however, has drawn out a great many buyers, who have been holding back for the lower prices which increasing capacity seemed to secure. Crude iron, of course, shows a downward tendency, all other kinds an upward tendency, except perhaps, rails, which are steady and firm. Bridge, plate, tank, bar and sheet iron are all in fair demand, but there is nothing of a booming tendency anywhere. The trade prefers low and regular prices, and in spite of strikes, the course of prices is downward as capacity expands.

PHILADELPHIA SEWERS.

The recent political reform movement in Philadelphia seems to be extending also to engineering matters, which, from all accounts, are sadly in need of improvement. On Monday an ordinance was passed by the city councils directing the chief engineer hereafter to build all sewers having less sectional area than a circle 4 ft. diameter, *egg-shaped*. Heretofore all sewers, of whatever size and for whatever purpose, were built circular. It is astonishing that to this day egg-shaped sewers have been under a ban in Philadelphia, while almost all other cities have long ago fully conceived their advantage. But what is more astonishing is the fact that city councils must pass an ordinance to this effect. We have been under the impression that the *shape* of a sewer is a matter belonging to science; that it varies with the duty the sewer has to perform; that it should be adapted to each particular case, and that it is the province of the city engineer to determine it. But we seem to have been mistaken. The Philadelphia council have "ordained" that all small sewers shall be egg-shaped. It is therefore not allowable, for instance, to lay down any circular pipe sewers, as the *smallest* public sewers built in Philadelphia have been 3 ft. in diameter. This point, however, did not occur to the authorities.

We are glad to see that the sewerage of our neighbors is to be improved by the City Fathers passing this ordinance, although it contains this objectionable feature. It is far better than to persist still longer in the ancient method of building large circular sewers to drain a single house. But we regret to see that the profession of city engineering is to be bound by other laws than those of science and economy in determining the best designs for public works, and hope that the example will not be followed elsewhere.

KNOXVILLE (TENN.) WATER-WORKS.

At a meeting of the Aldermen of Knoxville on the evening of the 16th inst. the bid of the Knoxville Water Co. for the erection and maintenance of water-works of that city was accepted after considerable discussion by a vote of 9 to 6. The only other bidders were the "Knxville City Water Co." and Messrs. J. A. Cloud & Co., 18 Wall street, New York. The present water-works are to be built upon the "Moses Lane" plan of 1879, or not as specified by the City Council, and whether on that plan or on the plan and specifications submitted by the contracting company the works and machinery are to be equal in capacity and quality to those designed by "Moses Lane, Hydraulic Engineer." The reservoir is to have a capacity of 8,200,000 gallons; there will be 75 hydrants; 2,000,000 gallons will be supplied every 24 hours; private persons are to have water at 5 cents per 100 gallons; work to be commenced within 30 days from signing contract, and to be complete within 12 months thereafter; company to lay its pipe, etc., and maintain the works in good condition for 30 years or until purchased by the city; failure to commence work or to complete as above subjects the contract to forfeiture; the company may issue only $125,000 in the next five years and thereafter only $25,000 additional; the company to erect telegraphic fire alarm; the city to grant right of way, etc., and to pay as the annual rental for 75 hydrants the sum of $50 each; payments to be made quarterly, on the last day of each quarter; also to exempt the property of the company from municipal taxation for the period of five years from Jan. 1, 1883; the city may purchase at the end of 15 years upon assessment; the company shall not assign the contract for the construction of water-works, but may mortgage its property or subject portions of the work of construction.

By the proposed contract the city is not required to spend a single cent of money or to assume a single liability.

PHILADELPHIA CITY ENGINEERING.

(CIRCULAR.)

737 WALNUT STREET, MAY 24, 1882.

To The Members of the Committee on Surveys:

On Thursday, the 18th instant, I presented an ordinance directing that hereafter all sewers shall be built of an oval or egg shape—it was referred to your Committee.

The advantage of what is called the "egg-shaped" sewer is shown in the following sketch [which exhibits comparative diagrams of circular or egg-shaped sewer sections not necessary to be reproduced for the benefit of *our* readers.—ED. ENGINEERING NEWS.]

The same amount of water gives a greater depth of channel in the "egg-shaped" sewer than in the circular or round sewer, and consequently carries the sewage away quicker and cleaner.

This kind of sewer is in use in all the great cities abroad, is used in many cities in America, and is recommended by the best scientific skill.

I also at the same meeting of Councils presented an ordinance requesting and authorizing George E. Waring, of Newport, Rhode Island, upon such compensation as may be determined, to examine the sewerage system of Philadelphia, and report such suggestions for alterations and permanent improvements as he deemed wise and expedient. This was also referred to your Committee.

It is unnecessary for me to say anything in support of Mr. Waring's position as a sanitary engineer. His system for Memphis, after a year's experience, is referred to by William Henry Baldwin, in Vol. 3, page 270, of the Proceedings of the Engineers' Club of Philadelphia. His report on the New York City sewerage is found in Scribner's Monthly Magazine for May and June, 1881.

He has reported upon the sewerage systems in Baltimore, Norfolk and other cities. His suggestions would certainly be of use to the city.

There is nothing before Councils that the people are more interested in than the proper protection of their homes from sewerage gas, and a clean, healthy system of drainage, both house and sewer. Everything should be done that human skill and man's ingenuity can devise.

If Councils appropriate $100,000 from any surplus fund for main sewers, or hereafter make any appropriation for the same purpose, it would be well to have all the scientific information we can obtain, so that the work done in this city in the future will be to its credit and to the healthful benefit of its people. DALLAS SANDERS.

What sort of a town is Philadelphia, anyhow! It has recently re-elected its present City Engineer for the third term; it commissioned a very competent Sanitary Engineer, upon the recommendation of its City Engineer and in co-operation with the National Board of Health, to proceed to Europe to investigate the best methods of sewerage in use there, and it has been acknowledged by such authority as Mr. Chesbrough that the report prepared by Mr. Hering on the sewerage of Philadelphia is the ablest document on that subject that has been published for many years, and that it shows a most thorough and comprehensive knowledge of the peculiar needs of Philadelphia. That report, accompanied with a set of most admirably executed detail drawings, are now in the City Engineer's office. And yet, with all that has been reported for years upon the subject of Philadelphia sewers, it remains for *a lawyer*—not the City Engineer—to present to the Councils of the second city in the Union the above ridiculous circular, explaining the difference between egg-shaped and circular sewers, and telling the wise men that "this kind of sewer is in use, etc.," and also inviting Mr. Waring to come in and tell them what to do, on the strength of his Memphis sewerage and his popular magazine articles on New York shortcomings and his plan of helping them out. Mr. Waring now confidently asserts that Philadelphia will adopt his "separate" system and that he will "get his royalty." And he ought to get it if he has the genius and ability to enlighten and convert the apparently *very* ignorant, helpless and don't believe in-home-talent city government, that has devised the most skillful process of evasion of responsibility in all its departments that exists on this continent. It is however, really the "Philadelphia plan" to have a lawyer or a doctor devise its engineering, which is something after the style of the good-natured man who didn't care if his intended wife was slovenly, "he could get a clean hired girl."

Now that City Engineer Smedley and his chums in Councils have been enlightened on the existence and desirability of "egg-shaped" sewers, would it not be well to call in an apothecary's clerk, or a preacher, or some other intelligent Philadelphian to suggest a plan for a bridge or culvert, and possibly some other unemployed genius might be called in to help Dr. McFadden and the Water Department in the design of stand pipes and the cost of brickwork. Meanwhile civil engineers are notified that there is no hope for them among the Quakers.

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NEW PUMPING ENGINE, BROOKLYN.

In accordance with previous advertisement and specifications in ENGINEERING NEWS of the following proposals were received for fourth engine and pumps: George W. Whittaker, one beam and fly wheel pumping engine, 15,000,000 gallons capacity, to be placed in present engine-house, no new boilers, change in building or well proposed in bid, cost $89,500. A. J. L. Loretz, two double-acting condensing beam engines, 15,000,000 gallons aggregate capacity, separate building, new well excavation, etc., no new boilers or chimney proposed, cost $159,841. Clapp & Jones, two pair of beams and fly-wheel engines, 15,000,000 gallons aggregate capacity, to be placed in the present building, new boilers and chimney, no price named for chimney, etc., cost $93,000. H. R. Worthington & Co., one pumping engine, 15,000,000 gallons capacity, new battery of boilers, separate building, new chimney, etc., for engine and boilers, $79,000; for building and excavation, $38,000, cost $112,000; also two pumping engines 7,500,000 gallons capacity each; new battery of boilers, separate building, new chimney, etc.; for engines and boilers, $84,000; for building and excavation $88,000; cost $117,000. M. T. Davidson & Co., four pumping engines, 15,000,000 gallons aggregate capacity, new battery of boilers, separate buildings, well, chimney, excavation, etc., engine to be duplex or separate; for engines and boilers, $70,000; for building and excavation, $88,000; cost, $108,000. Holly Manufacturing Company, duplex pumping engine, 15,000,000 gallons capacity; new buildings, new boilers, chimney, etc., without excavation; for engine and boilers, $86,800; for buildings and chimney, without excavation, $29,228; cost, $116,028; for single building and chimney, without excavation, $25,848; cost, $112,648. The cost of excavation would be about $4,500. William Golding, pumping engine and boilers, $125,000; no bid or plans for building or foundations.

Proposal of M. T. Davidson was accepted, and the following will be the cost complete:

Engines and boilers	$70,000
Building, foundations, chimney, well, etc.	38,000
Force main, 36-in. diam. 3,600 ft.	50,000
Engineering, inspection, changes due to new buildings, etc	12,000
Contingencies	7,000
Total	$177,000

ENGINEERS AND ENGINEERING IN OTHER LANDS.

[Specially translated and prepared from our Exchanges.]

Engineers are beginning, or rather continuing, to show themselves patriotic. In the race for trade, the best and safest harbors, the most extended river communication and several similar advantages will constitute important factors. At the meeting of the French civil engineers a long paper was read by M. de Coene on the importance of deepening the Seine. An example of what may be done is seen in the tonnage of the Port of Rouen, which had, in 1880, 1,500,000 tons, as against 400,000 before the river was deepened by longitudinal dikes. The large steamers of the present day will require even deeper water, and all the French ports will have to be greatly improved. A new dike to cost 25,000,000 francs is advocated.

Up to the present, as is known, all the cables of suspended bridges are composed of metallic wires, parallel and tightened at certain distances by wire ties. The tension of these wires is, however, very unequal. A. M. Arnodin proposes to make cables in the same way as ropes by twisting. It would seem that such cables are from 10 to 11 per cent. stronger than those having rectilinear thread. Oxidation, too, cannot do as much harm.

A letter from Panama to a gentleman in this city gives a few details about men and things there. The letter is dated from Buhio Soldado and says: "I do not believe that much complaint can be made about the workmen here, and all the revolver stories that I heard about before my departure from France are pure invention. I would recommend all coming rather to provide themselves with a very large sun umbrella than with a revolver. The food given out to us is very good. The train which passes near our house twice a day leaves meat, bread and rice. A fowl costs from 1 franc 50c. to 5 francs; eggs are 17 centimes a piece; milk 75 centimes per liter. The use of alcoholic drinks in this climate is very dangerous.

CONSTRUCTION OF BRIDGE PIERS WITH METALLIC TUBES.

This system is applicable to bridges not over 40 yards in length, and has great advantage over buildings in masonry, in point of economy.

As seen in cut, pipes of from 0.50 meters to 1 meter in diameter are used, and these are terminated by pile shoes of a conical shape. Stakes of this kind are sunk in the required position, and then bound by beams and braces, so as to form a solid whole, and one offering great resistance. This resistance may be calculated from the following formula used for wooden stakes in a sandy soil:

$$P = 80\, W + 0.228\, (\sqrt{F} - 1)$$

W representing the weight of the pile driver in tons, and *F* the height of fall calculated in English feet.

The formula shows that the resistance offered by the pile increases proportionately to the weight of the pile driver, and to the square root of the height of fall of the latter.

The cut represents the simplest system where a pier formed of two uprights inclined to ¼ are joined by horizontal braces and inclined bars, and on the summit of which is the flooring of a bridge of 80 meters span. Each upright is composed of a pile-pipe *A*, the top of which is at low water level, and this is surmounted by another pile *B*.

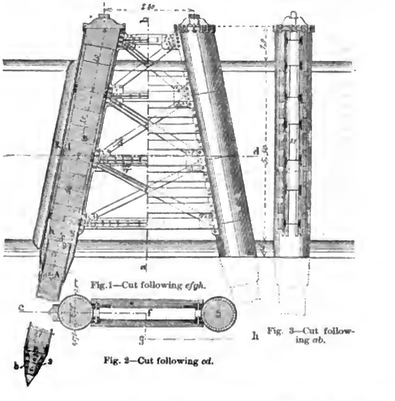

Fig. 1—Cut following *efgh*.

Fig. 2—Cut following *cd*.

Fig. 3—Cut following *ab*.

The pipe *A* is of boiler-plates, and riveted so as to be water tight; it ends in a conical surface *a*, to which a ring in cast steel *b* has been riveted. In the lower part of this ring, the cone of cast steel *c* fits in, and forms the pile shoe. The monkey of a weight of 5 tons strikes a sheet of cast steel *e*, which bears both on the shoe and the upper and inside surface of the steel ring *b*. The pipe *A* is then filled with a column of cut stone, and a metal plate *f* placed on it so as to distribute the weight equally on the pile. Immediately under this plate, the ring in cast iron *g* is fitted in. It is furnished with a rim having 10 notches, into which an equal number of keys *g* are hammered, and this arrangement has the effect of transmitting the strains from the pipe-pier to the pipe-pile.

This latter *B* is terminated inside in the shape of a truncated cone, surrounding the tube *A*, and serves during the hammering of the latter as a coffer-dam for keeping back high water. As may be seen, the pipe-pier *B* does not rest directly on the pile *A*, but on the upper plate *i*. The weight of the flooring is, therefore, thrown on the filling column in cut stone, which transmits it to the pile *A*. The piers are sunk as follows: the pipe *A* being placed in the requisite position, the pipe *B* is fastened on to the head. The two tubes are brought together temporarily by the gibs *h*, then the pile driving is kept np until the tnbe *A* has sunk to the necessary depth.

The fifth general meeting of the German Architects' and Engineers' Union will take place in Hanover, from Aug. 20 to 24. It is thought that some 7,000 members will be present. Some very interesting questions, from an engineering and economic point of view, will be discussed—among them the improvement of water courses, with reference to agriculture; the best methods of deciding pnblio contracts; conditions for delivering iron.

The discussion about the best system of sewers for Paris is not yet satisfactorily settled. Whether to send *everything* or *nothing* to the sewer is the explicit French phrase. In either case the present system of pits must be done away with. If the entire quantity of slops must go into the sewers, there must be an abundant supply of water to flood the pipes. The amount of infectious matter now being distributed from the Paris sewers is stated to be very great. Of 1,000 openings examined, a current of had air from the sewer into the street was detected in 500 cases. The question whether typhoid fever is not a direct effect of sending fœcal matters into the sewer is also attracting attention. Mr. Waring's works on sewers in America were brought to the attention of the French Société Hygiène at their last meeting by Dr. Pietra-Santa. The questions of incline and of tides are very important in considering the matter, and, in both respects, Paris is at great disadvantage. Experiments are now making in the district between the barrack of La Pepinière and an experimental place at Levallois-Perret.

Prof. Steiner lately exhibited before the Austrian Engineers' Society a new instrument for measuring the tension of bridge works. It is the invention of Prof. Fraenkel, of Dresden, and shows the elongation or shortening of the fibers of such parts as it is fastened on. The diagram is made automatically. Such measurements as have already been made with it show a close similarity in the change of elasticity between the calculated and the observed. The instrument is to be improved, however, hy having an optical device, instead of the instrument of precision consisting of a lever.

One of the great engineering works of the "late past" is nearly completed. The course of the Rhine has been changed and corrected on that portion of it, which lies along Baden, Switzerland and Alsace. Yet there can be little navigation from Strasbourg to Basle, and it is for this reason that the German Government contemplates the cutting of a canal from Ludwigshafen to Strasbourg. The first estimate is placed some $8,500,000. The sand banks are the great obstacle to Rhine navigation, and it is thought that these improvements will, in the conrse of years, remove them. The deposits of the Alsatian side move along that bank; hnt those of the Baden bank are carried along the opposite side. The works were begun in 1842 by the French and Baden governments. The plans of the Baden engineers were accepted in preference to those of the French, who wished to preserve the natural course of the river. In former years the French and German engineers seem to have simply thrown the current from one bank to the other alternately. It is rather singular that the works, which were estimated to cost 114 million of francs in 1840, the expense has been some 15 millions less. There is less infiltration along the new bank, and the intermittent fevers which had raged for centuries have disappeared. The Rhine flows calmly along in its new bed, but great works will yet be necessary before the river can be made what it should be. Its mysterious dwindling away as it approaches Holland may yet be prevented, hnt how to prevent such great percolation to subterranean depths is a problem the engineers have not yet solved.

The last issue of *The Ironmonger* has the following statement in regard to engineering in Russia: Complete stagnation prevails at all the engineering works in Russia. Various statements are in circulation in regard to the alleged decision of the Emperor to revive the Black Sea fleet at an outlay of 10,000,000 roubles. If Russia decides on establishing an iron-clad fleet in the Black Sea she will have to first extend the existing Southern dockyards, which will mean the purchase of a large amount of machinery in England. When this is accomplished she will become a buyer of a larger amount of coal, and will obtain most of the iron and steel from England for the vessels to be constructed. It is said that the dockyard will be removed from Nicolaieff to Sebastopol, in which case the purchases of new machinery will be of a very extensive character. There is also a talk of establishing an auxiliary dockyard at Batoum.

PERSONAL.

MR. E. P. PLEASANTS is chief engineer of the Baltimore & Delta Railroad.

MR. F. S. WALLACE is Chief Engineer of the Marietta & North Feorgia (N. G.) Railroad, with headquarters for the present at Jasper, Ga.

MR. ALBERT J. TWIGGS has resigned the position of superintendent of the Augusta & Knoxville Railroad in order to take the contract for grading the Savannah Valley Railroad from Dorn's mine to Anderson.

MR. CABELL BRECKENRIDGE, chief engineer of the Chattanooga & Vicksburg Division of the Cincinnati, New Orleans & Texas Pacific, in stepping from his private car at Vicksburg recently, fell and dislocated his ankle. He was conveyed by special train to his home in Tuscaloosa.

MR. A. B. ATWATER, AssistantT raffic Superintendent of the Port Dover & Lake Huron division of the Grand Trunk, and formerly Assistant Engineer on the Lake Shore & Michigan Southern and the Canada Southern railways, has been appointed Chief Engineer, vice J. C. James, resigned, of the Chicago & Grand Trunk Railway.

ENGINEER OFFICERS PROMOTED.—The promotions of First Lieutenants Richard L. Hoxie, William L. Marshall and Joseph H. Willard, Corps of Engineers, U. S. A., to be captains, to date June 15, are under section 9 of the act of March 3, 1853, which promotes to that grade, though without increasing thereby the number of officers allowed in the corps, all officers who have served fourteen years continuously as lieutenant. The promotions of Lieutenants Albert H. Payson and John G. D. Knight to captain are to fill vacancies created by the deaths of Colonel Twining and Major Howell.

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THE WATERPHONE.

This instrument for detecting the waste of water, the invention of Assistant Superintendent Bell, of the Cincinnati Water-Works, according to the reports in the daily journals of that city, has been performing most efficient service. Mr. A. G. Moore, Superintendent and Engineer of the works, reports to the Board of Public Works as follows:

We have given the device of Mr. Bell a thorough and practical test, and find it to be a meritorious invention, and an invaluable instrument for water-works purposes.

It is void of complication in construction, simple in adaptation, inexpensive in application and most effective in results—a mere drip being distinguishable.

There have been ten different tours of inspection, consisting each time, with one exception, of only one gang of two men. Two hundred and sixty leaks and abuses have been discovered.

The nature of the wastes have been found to be due proportionally about as follows:

20 per cent. to designed abuses in water-closets.

60 per cent. to carelessness in leaky taps and connections, and failure to close stops.

20 per cent. to underground leaks.

The extent of these wastes may be better understood by the following table, in which the discharge of a ⅝-in. lead pipe 70 ft. in length for 24 hours under the several pressures is given, as well as the cost of water figured at meter rates of 12 cents per 1,000 gallons:

Pressure.	Discharge.		Gallons.
10 lbs	9, 00	gallons	$1.14
20 "	13,700	"	1.64
30 "	15,700	"	1.88
40 "	17,700	"	2.12
60 "	24,000	"	2.88
80 "	28 800	"	3.45
100 "	31,700	"	3 80
120 "	34,500	"	4.14

The large increase in plumber's reports of repairs to water connections on file in this office shows the effect of the work already accomplished, and that the water consumers are beginning to understand the necessity of prompt attention to the correction of leaky faucets, etc., for they do not know how soon the Water-Works Inspector may call on them unawares.

The use of this instrument is undeniably of great utility in determining the improper conditions and uses of the service branches, and as Mr. Bell has to this time permitted a gratuitous use of them with fine practical and financial results, the permanent right to use same should now be secured.

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SYSTEMS OF SEWERAGE.

We are favored with advanced sheets of the July number of the *Sanitarian*, published in this city, and from a comprehensive article in it entitled "The City Needs a Change of Air," by Dr. Richard McSherry, of Baltimore, Professor of Principles and Practice of Medicine, University of Maryland, we quote briefly:

Dr. McSherry's paper is highly interesting, and though intended for the latitude of Baltimore mainly, which in some respects is peculiar, yet the principles advocated will find application in all of our large citities, and he points out with much force, how a "change of air," which many are seeking at this season of the year, by a change of habitat, may be secured as well by a little attention to small matters of great sanitary value, not requiring an exodus from our homes in order to render effective. From the paper by Dr. McSherry, space will not permit more than the following brief reference to the vaunted "system" pursued in Memphis, and the present results, together with Dr. Bell's clear definitions of a proper system of sewerage.

Dr. Bell, it will be remembered, has for many years devoted his attention to matters of sanitary progress and the dissemination of the principles of hygiene, and the *Sanitarian*, now in its tenth year, edited by him, deservedly takes rank as among the most valuable of our monthlies.

"Baltimore is to be congratulated," says the *Sanitary Engineer*, "on having an engineer of the skill and experience of Mr. Latrobe to carry out a work that is at this time somewhat of a pioneer movement in its application to cities of its size and characteristics."

Is it not strange that there should be any *pioneering* in sewerage at this time of sanitary engineering? The rule is that the pioneers in this work have rarely had more than partial success, while in not a few instances their failures have been most signal.

With some sanitary changes not diffcult of accomplishment, Baltimore can afford to wait until some system is proved by time and use to be fully worthy of adoption.

In most of our cities the sewerage is notoriously defective, notwithstanding the money and skill expended upon them.

Memphis now claims the greatest success in sewerage. A few years ago that city was in a frightful sanitary condition, and the result was disastrous epidemics of yellow fever in the years 1878-9. The city appeared to be doomed. But the people, with one accord, determined to rescue it from destruction. They went to work so earnestly in sanitary improvement, by a general cleansing, repairing of streets, emptying the foulest of foul sinks, and principally by a great system of sewerage under the directions of Col. Waring, that in a year, under the general renovation accomplished, they held a civic jubilee, a redemption day, a sort of sanitary Declaration of Independence, on the 22d day of September, 1880.

Full success was well merited, but was only partially obtained. In looking over the returns in the *Sanitarian*, and the bulletins of the National Board of Health, we find Memphis to be still amongst the most unhealthy cities in America. I offer the fact without comment, and certainly without asserting anything more than that the system of sewerage has not so redeemed it as might have been hoped and expected.

An editorial in a recent number of the *Medical News*, in treating of the "Lesson of Memphis," uses the following language: "The system of sewerage has been introduced, but it does not discharge into the Mississippi; it has been turned into Wolf River, a few hundred yards below the waterworks. The bayous have not only not been kept free from filth, but the sewers have been allowed to overflow into them. Only such sub-soil drainage has been introduced as was immediately connected with the sewers laid—an amount altogether insufficient, as Dr. Maury remarks, to secure good drainage; and the source of the water-supply has not only been changed, but fresh sources of impurity have been brought to it by the sewers. It is not to be wondered at that the mortality has rather increased than diminished; that the deaths from dysentery have doubled, and that the death-rate from consumption is higher than on the bleak New England coast; on the contrary, it is rather surprising that the mortality has not been greater."

In a private letter from Dr. A. N. Bell to myself, this eminent scientist remarks: "A system of sewerage, in the sense of being some special plan or contrivance by which some patent or device is worked into a system, is the bane of all good sewerage; and in this consists the chief defect of the sewerage of Memphis." The Field tanks so extensively used were not only unnecessary to a city with such facilities for any desired gradient as Memphis or Baltimore, but, as compared with a limited amount of waste or roof water for flushing, are absolute defects and useless expense. A *good* system of sewerage is that which is adapted to the locality; it may be in part combined and part separate, and there may be also in part necessity for flush tanks, and the literature of the subject shows that engineers who are competent to comprehend and combine these several conditions are the only ones whose work approaches perfect satisfaction."

THE OPENING OF THE ST. GOTHARD TUNNEL.

MILAN, May 22, 1882.

Italy, Germany, Switzerland, and we may say all Europe, have participated with thorough satisfaction in the ceremonies attendent on the opening of the St. Gothard Tunnel; but, as is usually the case, the promoter, the initiator, of that great international work has been almost entirely forgotten in his birthplace, Milan, as in his beloved Lugano, where he spent the last twenty years of his life, in study and poverty, dying there in 1869. Carlo Cattaneo, the greatest philosopher and political economist of modern Italy, the guide and inspirer of the Five Days of Milan in 1848, when the unarmed citizens defeated and drove out from their city the entire Austrian army under Radetsky, as early as 1859 insisted on the tunnel through the St. Gothard, in the interests of Italy and Switzerland alike. We have even now before us his letter to the Genoese, showing to them "that the new current of commerce coming from Suez, it behooved them to prepare to take advantage thereof." After passing in review the various projects for the Splügen and other passes, he continued:

"St. Gothard is not only a predestined railroad, it is a map of railroads which unite and open out for themselves a common center: it is the military center of Switzerland, the fortress of liberty. The safety of those Alps is our safety; the pre-Alpine line from Brescia, from Bergamo, from Lecco acquires fresh and practical value from the union of the plains of Erba with Como. The two cities of Como and of Lecco gain other advantages; the railroad from Varese must be extended to the Lake of Como, the railroad from the Lake of Garda be led up to Orta. All the industries of the higher valleys connected, commerce will be doubled by the completion of the Simplon and Mont Cenis railroads. Fortunate Genoa, which in this heritage of nature has the lion's share, such is the free interval from Constance to Basle, with almost the entire valley of the Po and of the Rhine, together with the long list of industrial cities, Zürich, Strassburg, Mannheim, Frankfort, Coblentz, Cologne, Elberfeld, Amsterdam, Rotterdam, Liége, Brussels, Antwerp, Ostend. The natural port of the Valley of the Rhine on the Mediterranean is Genoa. Genoa and Hamburg will be the two ports on which the Swiss will think when they think of their own homes."

Cattaneo then went on to show how the line of the St. Gothard offered to Genoa the shortest line of communication, surpassing in this respect, for the special commerce of Italy, the Lukmanier, the Simplon, the Cenis, or the Brenner, and, as regards foreign commerce, uniting Genoa with the above-mentioned cities by a much shorter line than they could be with Marseilles; how, in a word, as soon as the St. Gothard Railroad should be completed, Genoa could take into her own hands the commerce of the German Rhine with the East in the place of Marseilles. His counsels, eagerly listened to by the Genoese, were enthusiastically accepted by the Swiss, but it was not until April, 1869, that a regular project was presented to the Swiss Federal Council, to the Italian Government, and to the Confederation of Northern Germany for the perforation of the St. Gothard.

The St. Gothard, until the present century, had been one of the least frequented passes, although the hospital of the monks of St. Gothard was founded in 1331. In 1816, however, a regular post between five Swiss cantons and Milan was established, yet up to 1820 the path was only practicable for horses and pedestrians, and until lately the journey from Lucerne to Turin occupied twenty-five hours and a half, whereas the same journey henceforward will occupy but eight hours. The convention for the construction of this railroad was signed by Italy and Switzerland in 1869, and in 1870 the North German Confederation adhered to the Convention. Engineer Geipke and the geometrician Koppe were the chief designers. At first seven companies sent in their estimates—one Swiss, one Franco-Swiss, one Italian, one German, two English, one American. Finally L. Favre of Geneva, and the Italian Society of Public Works in Turin, headed by Grattoni, the constructor of the tunnel through Mont Cenis, were the only competitors, and to Favre the contract was assigned, his offer being considered the most advantageous. Meanwhile, the administration of the St. Gothard railway had arranged for the commencement of the excavations of the grand tunnel, begun in June, 1872. For the perforation the waters of the Reuss were utilized on the northern slope, those of Val Tremola on the southern. In 1879, Favre, who directed all the works in person, died suddenly of apoplexy in the tunnel as he was explaining the operations to some foreign visitors; nor was he the only victim, 179 workmen having lost their lives by accidents or suffocation, while hundreds of others have contracted maladies which sooner or later will bring them to the grave. One special form of anæmia, caused, it is said, by the insect *Anchylostomum duodenale*, has proved and is proving most fatal; indeed, a special hospital and convalescent home is being constructed for the survivors. The work, which was never interrupted, day or night, occupied nine years and three months—3,480 days in all. The first estimates of the sum total to be expended amounted to 227 millions of francs, of which Italy agreed to pay 55 millions, while various municipalities and provinces made up another 15 millions; Germany and Switzerland contributed 68 millions, the remainder of the sum being made up by shares, of which a vast number are held by Italians, so that in fact Italy has contributed far more than half of the sum total, the province and city of Milan alone furnishing two millions and a half.

The gallery of the St. Gothard runs in a straight line from the village of Göschenen to Albinengo, a village to the west of Airolo. The tunnel to be excavated along this line was 14.912 meters long, 2,700 meters longer than the gallery of Mount Cenis. In order to join it with the railroad which comes toward Airolo in an east-to-west direction, another gallery of 150 meters was excavated. The altitude at the entrance of the tunnel at Göschenen is 1,109 meters above the sea level; in the center 50 meters higher, at Airolo 40 meters higher. The geological formation differs essentially from that of the Cottian Alps. The bore of the gallery, after some 2,000 metres of granite or granite-gneiss, entered into crystalline schist, intersected with veins of serpentine, a mass, in short, of the hardest rock, which at first threatened to baffle the perforating machines. The hydraulic works were also extremely tedious, owing to the difficulty of obtaining a sufficiently strong body of water from the Reuss, while, on the Airolo side, during the winter, avalanches often obstructed the bed of the Tremola, rendering it necessary to excavate a bed under the snow. Signor Favre, in order to overcome the difficulty with the Reuss, constructed an enormous reservoir and a canal, while to baffle the avalanches he caused the water to be conducted by means of a wooden canal into the bed of a minor torrent, the Chiesso, less subject to avalanches. Other difficulties were encountered and overcome by his indomitable will, so that at his death it may be said that only the mechanical portion of the work remained. This was completed really in December, 1881, but the inauguration was delayed until yesterday, owing to various circumstances.

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It remains now to be seen whether Genoa will have sufficient skill and enterprise to profit by this enormous boon. It will not suffice that she is the nearest port to the great commercial cities of Germany and Switzerland. She must render her port and harbor safe and commodious as is Marseilles, her ship dues as low, her porters less insolent and exorbitant in their charges, or else the great French seaport will continue to outrival her as heretofore.—*N. Y. Nation.*

HARLEM RIVER BRIDGE.

The West Side & Yonkers Railway, New York, is a corporation that was formed for extending the elevated railway system on the west side of New York City over the Harlem River, to connect with the surface roads in Westchester County, particularly the New York City & Northern Railroad (once the New York, Boston & Montreal Railroad). This connection is about a mile long, commencing at the end of Eighth avenue, the terminus of the Metropolitan Elevated line, and ending at High Bridge, the commencement of the New York City & Northern Railroad, above noted. The principal engineering feature of the work is the bridge over the Harlem River and its approaches. In view of the contemplated improvements of the Harlem River by the General Government, the restrictions thereby created involved: 1st, a rectangular crossing with the contemplated bulkhead lines; 2d, a draw-span admitting of not less than 120 ft. uninterrupted water way either side of the pivot pier; 3d, masonry to be founded with reference to a future 18-ft. channel at low water. The above restriction of location involved the approach work on a curve at either end of 450 ft. radius. The whole work is for double track and proportioned on a somewhat lighter basis than is usual for first-class American bridges, since it can never be subjected to heavy freight engines or freight traffic. The river bridge consists of a central draw-span 300 ft. long and a deck-span of 100 ft. at either end, provided with foot-walks on either side in view of contemplated streets along the proposed bulkhead lines laid out for the river improvement. The above is all pin-connection work, and is supported on granite piers. The approach work on either side consists of riveted lattice and plate girders, the lattice work being so designed as to make the center lines of the web members intersect in the center lines of the chords. The riveting was more carefully performed than is usual in American work of that character, the holes all being punched small, and reamed out when parts were assembled to receive the rivets. The piers for the approach work are Belleville brownstone coped with granite. These piers were placed radially to the curves of approach, and were located and instrumentally maintained by a system of triangulation and intersecting lines. No direct measurements were made for any of the piers, and the whole has been a model of careful field work performed under the immediate direction of Mr. C. L. Cooke, Principal Assistant Engineer in charge of the work. The foundations across the river and on the New York side are in piles, and on the Westchester side, the start from the alluvial drift. They were all obtained by means of coffer dams, excepting the pivot pier, which was founded by means of a caisson with movable sides. The mode of coffer-damming was by driving a single row of tongue and grooved 6-in. planking with a pile-driver, bracing internally as the water was lowered and excavations made. At the site of the bridge, the Harlem River bed consists of a plastic mud varying from 6 ft. to 20 ft. in depth, overlaying a deposit of sand from 5 ft. to 15 ft. in thickness, under which is found a stiff clay running out to a knife edge on the Westchester side, where the alluvial drift is immediately below the sand. The 18-ft. channel involved piercing through the mud into the sand, and the above device for coffer-damming answering an admirable purpose, against a head of, at times, 22 ft. of water. Frequently the sand in the bottom gave a great deal of trouble, boiling springs breaking through and frequently carrying a stream of sand from under the toes of the sheet piling plank. Ordinarily an 8-in. pump would hold the bottom until piled, but one foundation was exceedingly troublesome, requiring a 12-in., an 8-in., a 6-in. and a 4-in. pump to hold the bottom until piled and concreted. The granite employed in the river bridge was in two colors, dark and light, the latter being used for coping, weathering and band courses, which was all bush-hammered work, and the former rock faced for the body of the piers. The red sandstone approach piers are all rock faced, which contrasts handsomely with the light granite coping. The draw-span is the portion of the superstructure of more special interest. It being up to date the largest double-track draw in the world, and is rather novel in general design and details. It was computed on the theory of no end reaction whatever from the dead load, when closed and loaded on one or both arms, the usual assumption now made in America for continuous draw-bridges. There being an ambiguity at best, in proportioning such bridges, a single system of web arrangement was adopted in panel lengths of 17 ft. 4 in., the diagonals towards the center being in sets of four. The truss is 20 ft. deep at ends, and 40 ft. deep at the center. There are two trusses 26 ft. apart centers, with sidewalks cantilevered out from suspended cross girders. The turn-table is a rim-bearing table solely, made with extreme care, machine faced and turned in all moving parts. While the truss delivers its load to four central posts, the bearing table is so arranged as to divide on eight symmetrical points on the drum, thus distributing the whole weight over all the wheels. The machinery for operating the draw is all within the table, and consists of a double (5 in. × 7 in.) cylinder oscillating engine, with shafting and friction clutches. The free ends of the draw are supported on cams, connected with the levers of which are a system of toggle joints and levers for raising the rails clear and free from the permanent work, the whole being operated from the central engine by line shafting beneath the floor. The mechanical attachments are such that, with the first movement of the capstan wheel which connects the engine with friction clutches, raises the rails, following which the cams are drawn, when the span hangs free. The second motion of the capstan throws the table shafting into gear and the bridge swings. An indicator in front of the operator always shows the exact position of the bridge and defines its centering position. The turn-table is also provided with hand motion, and on a still day three or four men can readily open the draw.

The engine and mechanical details were supplied by Joseph Edwards & Co., of New York. The flooring system of the whole structure is heavily timbered and guarded, making it impossible for a derailed engine to endanger the structure. The time occupied in construction was one year from commencement to the passage of trains, although considerable additional time was absorbed in general finishing touches, painting, etc. The following is the schedule of spans, with weight of iron employed in same—all double track, commencing at terminus Metropolitan Elevated Railroad.

	Lineal feet.	Lbs.	
4 lattice spans, each......	60	234,234	on curve 450 ft. radius.
1 pin connection..............	100	166,125	river bridge.
1 "	300	711,758	draw span.
Turn-table, gearing, locking gear, etc..................	....	179,472	
1 pin connection..............	100	166,125	river bridge.
3 lattice, girder spans, each..............................	60	175,668	on curve 450 ft. radius.
1 skew lattice span........	80½	123,823	on curve 450 ft. radius over N. Y. C. & H. R. R. R.
Lineal feet plate girder viaduct..............................	276½	197,321	on curve 450 ft. radius to tangent point on abutment.
Totals........................	1,386	1,954,546	—*Engineering.*

FINELY TEMPERED SWORDS.

The art shown in sword making was not by any means confined to beautiful forms and elaborate ornamentation. The greatest skill was exercised in the manufacturing and tempering of the blade, which, in the days when swords were not only worn but used, was more important than any *other* part of this weapon. In Europe, the sword manufacturers of Spain first began to have a reputation for producing work of superior quality, and the armorers of Toledo stood foremost among their countrymen. A "Toledo blade" was considered to be a weapon of great value, and, even now, when we wish to speak of something remarkable fine-tempered and sharp, we compare it to one of these swords. The peculiarity of the Toledo blade was not only its extreme hardness, which enabled it to receive and retain the sharpest and most delicate edge, but its elasticity, which allowed it to be bent without being broken. Some of the most famous of these swords could be bent so that the points touched the hilts, and yet they would spring back to a perfectly straight line. It is said that in Toledo sword-blades have been seen in the cutlers' shops coiled in boxes like watch-springs, and although they might remain in this position for some time, they would become perfectly straight when taken out. Other places in Europe were also famous for producing good swords. Many excellent weapons were made in Italy, and Andrea Ferrara, the Italian sword maker, who has been mentioned before, was better known throughout Europe than any other of his craft. To possess a genuine Ferrara blade was considered a great thing by the nobles of France and England.

But it is to the East that the world owes the production of the most finely tempered swords it has ever seen; and the steel of Damascus has been celebrated for many hundred years as superior to any other metal that has ever been made into sword blades. Even the cutlers of Toledo doubtless owed their skill and knowledge to the Moors, who brought from Damascus the art of making blades that were as hard as diamonds, as sharp as razors, and as elastic as whalebone.

Wonderful stories are related of these Damascus swords. We have been told that with one of them a full-grown sheep could be cut in half at a single blow, a heavy iron chain could be severed without turning the delicate edge of the sword, and a gauze veil floating in the air could be cut through by one gentle sweep of the glittering blade. These wonderful scimitars are not manufactured now, but their fame has exceeded that of any other weapon of their kind, and it is quite certain that their extraordinary excellence has not been exaggerated. It is probable that the workers in steel of the present day might be able to discover the peculiar methods by which the Damascus steel was made, but as there would be little use or demand for the blades after they had been produced, it is not likely that their manufacture will be attempted. We should consider, however, that although the present age is preeminent as an inventive and manufacturing period, there are some things which have been produced by the ancients and the artificers of the Middle Ages which we of the present day have not been able to equal. It is possible, therefore, that our steel workers might never be able to make a Damascus blade, even if they wanted to.

Some of the swords of Japan are said to possess wonderful qualities of hardness and sharpness. The story is told that if one of these celebrated blades is held upright in a running stream the leaves floating gently down with the current will cut themselves in two when they reach the keen edge of the sword.

But these Japanese swords, some of which were held in such high esteem that they were worshipped, and temples were built in their honor, were only hard and sharp; they had no elasticity, they could not bend and they might break, and in this respect they were far inferior to the splendid scimitars of the Moors and Saracens. — *From "Swords," by John Lewees, in St. Nicholas for July.*

NOTES.

Relighting Safety Lamps by Electricity.

Safety lamps when extinguished by fire-damp must, as a rule, be taken to the surface to be relighted, and the loss of time and the expense which this proceeding entails have caused Messrs Hubert & Durant to propose a method of relighting safety lamps by electricity, and that without opening them or removing them from the air, which may at any moment become explosive. For this purpose the bottom or reservoir of the lamp is provided with two tubes of metals, closed by tightly-fitting wooden plugs. These serve to hold and insulate two copper wires connected by a short platinum wire passing close to the wick. On making contact with a battery, the electric current raises the platinum wire to a white heat and lights the lamp. Various batteries have been tried for this purpose, but as portability, and at the same time high power were required, the bichromate battery was ultimately selected. This consists of a glass cell with wide mouth, containing bichromate of potash and water acidulated with one-tenth its weight of sulphuric acid. Generally one zinc and one carbon pole are immersed in this liquid; but, in order to increase the surface and therefore the intensity, Messrs. Hubert & Durant employ two zinc and four carbon plates. They also propose eventually to supersede the bichromate battery by that of Daniel, reinforced by a Faure accumulator. In order to avoid the sparks which are produced on breaking contact, and which would ignite an explosive mixture, two spiral springs hold the zinc and carbon plates clear of the exciting liquid, so that to make the current pass it is necessary to press the lamp firmly down upon the electrodes. As soon as the lamp is relighted the pressure on the electrodes is released; they rise from the liquid, the current no longer passes, and consequently no sparks are produced on breaking contact. Existing lamps may be modified so as to be lighted by electricity at a trifling cost, which, together with that of the battery, will soon be repaid by the saving of oil resulting from only lighting the lamps when they are required for use, instead of at the mouth of the shaft.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Wells.—Chief Engineer Spears informed the Long Island City Water Commissioners yesterday that the wells sunk by Tichener & Safford about three months ago are rapidly failing, and unless immediate steps are taken to procure an additional supply there will probably be a water famine during the late summer and fall months.—*World, June 21.*

The large increase in the consumption of water in Brooklyn has revived the talk of the necessity of enlarging the sources of supply. The well system is being discussed again. During the past ten days the average daily consumption has been 35,000,000 gallons, or about three and a half million gallons more than the corresponding period of last year.

Consumption at Milwaukee, Wis.—The following is a statement of city water consumed last week:

	Gallons.
Sunday..	11,503,938
Monday..	15,746,062
Tuesday..	15,547,698
Wednesday..	14,422,913
Thursday..	16,014,583
Friday..	14,933,748
Saturday..	15,377,419
Total..	103,636,391
Average daily..	14,805,198
Corresponding week in 1881..	14,606,235
Increase..	198,037
Coal consumed..	79.1 tons.

Gas-works are being erected at Birmingham, Ala. and will soon be in operation.

Water-Works for El Paso.—The material for water-works at El Paso, Texas, has all been shipped and the work commenced. The water will be pumped from the Rio Grande River into a reservoir, placed at an elevation of 100 ft. above the highest part of the city. About 6 miles of 12, 8, 4-in. pipe will be laid. Works to be completed by Sept. 1, 1882. Both of the above works will be erected under the plans and supervision of Sylvester Watts, of St. Louis, Mo., and owned by him and J. W. Parker, of Atchison, Kansas.

Reservoir.—Work has been commenced on the great water reservoir at Ripon, Wis., and it is expected that if all goes well a month will see it completed.

Water Supply of Peabody, Mass.—The Fire Department tested the capacity of the water supply Saturday, with a very satisfactory result. Before the trial the pressure at Pickering's store indicated 69 lbs. Six hydrant streams, that threw from 100 to 135 ft., caused the pressure to fluctuate between 63 and 72 lbs. Thirteen streams showed from 62 to 68 lbs. pressure, and 17 streams showed from 57 to 65 lbs. pressure. At the pumping station the pressure was reduced only 3 lbs. The hand engines, that have won high honors at musters, are to be sold.

The new water-works at Carbondale, Pa., give general satisfaction.

Pumping Engine Contract Let.—The Omaha (Neb.) Water-Works Company have lately contracted with the Knowles Steam Pump Works for two more compound condensing pumping engines, one of which is for pumping into the settling reservoir.

The New Water Tower.—The Water Commissioner was engaged yesterday in draughting a diagram of the water tower soon to be erected on Twelfth and Biddle streets. The new tower will be 165 ft. above the surface of the ground, and will be of the same dimensions as the tower on Grand avenue. It will cost $30,000, and will be connected with the engine-houses by four pump mains, which will cost $10,000 each. The old tower has two pump mains, and an additional one is now being constructed. The Commissioner expects to commence work on the new tower within eight months.—*St. Louis Globe-Democrat.*

Water-Works being Built.—Water-works are being built at Tucson, Arizona. Water will be brought from the Santa Cruz River, 5 miles from the city, through 12-in. mains, and distributed through 7 miles of 12, 6, 4-in. mains. The source of supply is 80 ft. above level of city. No pumps or reservoir will be used. The works will be completed by Sept. 15, 1882.

ELECTRICITY.

The Mexican Cable Completed.—Galveston, June 21.—At 5.30 to-day the final splice of the Mexican cable was made by the steamship International, off Brazos, Santiago, placing Galveston in direct communication with Vera Cruz and telegraphic communication with the whole of South America.

The Telegraph in China.—To induce the people to make themselves familiar with the operation and utility of the telegraph, the Chinese authorities have shrewdly made the use of the new lines free for the space of one month.

RIVERS AND HARBORS.

The Island Breakwater.—From the *Toronto Mail*, we clip the following item: "Mr. John Perley, of Ottawa, has prepared plans and specifications for the proposed breakwater for Toronto harbor, and they are now to be seen at the harbor office. The plans call for a line of cribbing 6,680 ft. in length, extending in a curve from near Gooderham's wharf to the southern extremity of Fisherman's island. Between the latter and the main island the cribbing will extend a distance of 2,380 ft., where a gap 500 ft. in breadth will be left. From the eastern end of the main island the cribbing will be continued westward along the lake side for 6,550 ft., making in all 15,460 ft., or nearly three miles.

STREETS, DRAINAGE, ETC.

The Sewerage Question.—A dispatch from Brockton, Mass., says: A petition is now being circulated among the residents of this city in relation to the immediate construction of public sewers, and has received the signatures of some of the heaviest tax-payers in Brockton. The petition will in due time be presented for the consideration of the Municipal Government.

RAILROADS.

New Locomotive Works.—It is claimed that $500,000 have been subscribed for the purpose of establishing a locomotive works at a point just west of the city limits of Chicago, and that contracts have been let for the erection of buildings to cost $102,000, to comprise machine shops 458 by 88 ft. and two stories high; a foundry, 200 by 82; a boiler shop, 200 by 82; blacksmith shop, 200 by 52; a tender, truck and paint shop, and a pattern shop. The establishment, which will be called the Chicago Locomotive Works, will, it is said, be under the superintendence of Franklin D. Childs, now superintendent of the Hinkley Locomotive Works, at Boston. This project, which was announced a good while ago, has seemed to have the flavor of a real estate speculation, but it may be that the locomotive works feature will be carried out. More definite information, however, is desirable.

San Pete Valley (N. G.).—This road was built in 1881 from Nephi, on the Utah Southern, southeasterly to Wales, Utah, 30 miles. It has been decided to build an extension from Nephi north about 40 miles to Springville, on the Salt Lake extension of the Denver & Rio Grande, and another from Wales south to Manti, 20 miles.

Extension.—The Milwaukee, Lake Shore & Western line has been opened to Pelican, Wis. Eleven hundred men are pushing the road beyond Pelican.

Construction Work.—Reports from Milwaukee state the grade on the Chippewa Valley & Superior road, as well as the bridge work, were completed Thursday. The track is now within five miles of Reed's Landing, the western terminus. The branch from Durand to Cedar Falls, a distance of twenty-two miles, is well along, and the contractors expect to complete the grading work by the 10th of July. The contractors, Wells, Harrison & Green, who also have charge of the construction work on the Toledo & Northwestern branch of the Chicago & Northwestern road, projected to run from Eagle Grove to Alton, on the Chicago, St. Paul, Minneapolis & Omaha line, state that the grade will be finished Aug. 1. The track laying has progressed as far west as Peterton, 83 miles west of Eagle Grove. They also state that 400 men and 200 teams are at work between Schleisingerville and Neenah. This force is being augmented as rapidly as the right of way is being secured. Condemnation proceedings have been begun in many cases.

Water-Works Completed.—Atlantic City, N. J., June 18.—The Atlantic City Water-Works Company made their connections at 7 o'clock this evening. During the evening water was distributed through their pipes on all the avenues in the city.

Steel Rails.—Four thousand tons of steel rails are discharging at College Point, sixty miles above New Orleans for the New Orleans & Mississippi Valley Railroad, recently bought by R. T. Wilson & Co., of New York. The engineer corps are pushing forward in the direction of Baton Rouge, through the sugar plantations on the banks of the Mississippi, and tracklaying will soon begin.

Tracklaying has commenced on the Nebraska, Topeka, Iola & Memphis Railroad at Girard, Kan. The road will be completed to Walnut by July 4. Coal has been reached in the Prospect shaft, one mile east of this place, at a depth of sixty-five feet.

New Road.—Certificate of incorporation was filed at Albany on the 19th by the Addison & Northern Pennsylvania Railway. The company is to continue in existence one hundred years. The road is run from the New York, Lake Erie & Western Railroad at Addison, Steuben County, to a point on the State line between New York and Pennsylvania, on the southerly boundary of Steuben County. The length of the road will be twelve miles. The capital is $600,000.

Canadian Pacific.—The last rail of the Canadian Pacific Railroad, between Prince Arthur's Landing and Winnipeg, Man., was laid last Saturday, and the eastern territory now has communication with the Prairie province practically independent of United States railroads.

Southern Road Incorporated.—On the 19th articles of incorporation were filed in the Secretary of State's office, Little Rock, Ark., of the Springfield & Southern Railroad Company of Arkansas; capital stock, $3,500,000. The proposed railroad begins at a point on the northern boundary of Arkansas below the line of Taney County, Mo., and runs in a southwestwardly direction to Little Rock.

Over 1,000 Miles Each.—There are in the United States 16 different railroads, each of which controls and operates over 1,000 miles of track.

Ontario & Quebec.—Some 200 men are now employed on the Ontario & Quebec Railway between Perth and Moberly, while excellent progress is being made on the Midland between Perth and Sharbott Lake.

The Lac Vieux Desert Railway Company was organized under the laws of Michigan, and its projected line runs northwest from Menominee to Lake Agogebic, where it touches the Milwaukee, Lake Shore & Western's projected road. During the past year the surveyors have been busily engaged in locating this new line, but no construction work will probably be done before the middle of the season of 1883.

A Pennsylvania Road.—The building of the new Shamokin, Sunbury & Lewisburg Railroad is being pushed forward with great energy. There are now upwards of 1,000 laborers engaged in the work.

Locomotive Trade.—The Baldwin Locomotive Works have orders enough on hand to keep their three thousand men employed the whole year. The firm is constructing locomotives at the rate of 600 a year. Of those now being built, 50 are for the Philadelphia & Reading and 60 for the Pennsylvania Railroad.

Branch Road Projected.—Springfield, Mo., June 15.—Close upon the heels of the announcement that the St. Louis & San Francisco Railway Company will on to-morrow commence work on a branch road from Springfield to a point on the Mississippi in the southern part of Arkansas, comes a well-authenticated report that the same company are considering a project to build a railroad from here northward through Bolivar and Warsaw, and connect with the Chicago & Alton at Marshall, Saline County, Mo. Meanwhile there is no abatement of the building and immigration boom here, and the rapidity with which Springfield is becoming a city of commercial importance is phenomenal.

New Railroad in Virginia.—The Shenandoah Valley Railroad, extending from Roanoke, Va., to Hagerstown, Md., has been completed and opened for travel. The road forms a direct line between Northern cities and South and West. The length is 240 miles.

Work on the Ft. W., C. & L. Railroad.—The Ft. Wayne, Cincinnati & Louisville Railroad Company are making decided improvements in their road-bed this summer. New bridges, culverts, etc., also steel rails, are being put down, and work generally to put the road in first-class condition is being done now.

The St. Louis & Western Railway.—The old Laclede & Fort Scott Railroad, running from Lebanon, Laclede County, due west across the State to Fort Scott, Kan., has within the past year changed hands and names. It still, however, under the name of the St. Louis & Western Railway, retains all the desirable features of a most remarkable charter granted in 1867, prior to the new Constitution, allowing of the extension, at will, of branches through any of the counties of the State. The new directors have taken advantage of this provision and have projected branches from Bolivar, on the main line, to Kansas City, passing through Clinton; a continuation of the branch from Clinton passes through Tuscumbia, where it is joined by another branch from Bolivar, and goes thence to St. Louis. From Bolivar there is also a branch to extend through Lamar to Carthage, thus giving a more direct line to the Southwest portion of the State than even that of 'Frisco. The 'Frisco line passes through Lebanon and Springfield, at the first making a junction with the main road, and at the second with another branch from Bolivar. A branch is also projected from Lebanon to a point opposite Chester, Ill., where it can make connections with the great trunk lines south from Chicago. The arrangement of the system is such as to give the company a road from Kansas City to St. Louis and from either of those points to the southwestern part of the State, going via Bolivar. Upwards of ten years ago between $300,000 and $400,000 was expended upon the road building from Lebanon west, and also a short strip of 17 miles from Nevada City toward Ft. Scott. The road being in the hands of a receiver after the panic, the Missouri, Kansas and Texas squatted upon this 17 miles of road-bed and has been using it ever since. On June 19 the stockholders met in Nevada City and placed the first mortgage upon the charter. This was for the sum of $12,000,000, which it is computed will be sufficient to build the 600 miles of road which is to compose the system. The bonds are to be issued only as the road is built and according to the mileage, the amount being arbitrary. Of the old county bonds subscribed by the counties, Laclede County issued $110,000, Dallas County $250,000, Polk County subscribed $250,000 and issued $83,500. These various sums were expended on the road. Laclede County has paid the interest on the bonds; Polk County has done the same, but Dallas County fell flat from the first. Vernon County and the city of Ft. Scott paid for the grading of the 17 miles now occupied by the M., K. & T. Railroad. Work will be pushed on the main line immediately, both from the east and west end. This completed, the branches which promise the most will be constructed. Ties and rails are being received at Lebanon now, and it is expected that the main line will be completed during the present year. The stockholders, while at Nevada City, elected the following directors and officers: J. N. B. Dodson and W. W. Prewitt, of Nevada City; B. F. Helper, of Ft. Scott; J. W. Farmer and C. E. Bushnell, of Bolivar; George W. O'Bannon, of Buffalo, Mo.; W. R. Hall and H. Ottaway, of Lebanon; Ozias Bailey, of St. Louis; Z. E. Elkin, D. M. Yeomans, William P. Watson and John C. Short, of New York City, directors; and J. N. B. Dodson, President; D. M. Yeomans, Vice President; H. Attaway, Secretary, and William P. Watson, Treasurer.

Connotton Valley.—It is reported that the contracts for completing the Connotton Valley Railroad have been placed upon extremely favorable terms. The steel rails are contracted for at $51 per gross ton, and are being delivered on the ground. Laying of track commenced on the 15th inst., and it is expected that trains will run into Coshocton by Oct. 1, and to Zanesville before the close of the year. It is under consideration to put on a tug and two barges to connect the business at the company's dock at Cleveland with the lower harbor, which will be probably done by gentlemen outside the company, but interested in its progress. This project has been carefully considered, and it is the judgment of all that it will add very largely to the business of the company. The excursion business alone along the line will add for the season an average of $300 per day to the net earnings. A considerable saving will be affected on all the estimates in the plan of reorganization, and with careful economy it is claimed that the road can be put on a firm interest-paying basis, as it is indisputable that no road in Ohio is more favorably situated and with better terminal points.—*Boston Journal.*

CANALS.

Rome, Ga., has completed the survey of her proposed canal, and estimates the cost at $25,000 per mile.

The Panama Canal.—A Washington dispatch to the *Boston Journal* says: Mr. Thompson, ex-Secretary of the Navy, who is the American representative of De Lessep's Panama Canal scheme, is now here. He reports the progress of the canal as very flattering, that the difficulties relative to parts of the survey have been removed, that rock is being rapidly blasted, and that within a few days a contract has been let to an American company to excavate 7,000,000 cubic feet. Materials are all on the ground, and houses are provided for the workmen. He has less confidence in the Nicaragua plan than ever, and says that that company lacks and is likely to always lack what the Panama company has already secured, a charter and an abundance of money.

Georgia Canals.—About one mile of the canal through Cuyler's Swamp, near Savannah, Ga., has been finished.

CONTRACTS LET.

Boston, Mass.—The contracts for the People's Church, at the cor. Columbus ave. and Berkely st. have just been awarded to S. M. Chesley & Co., carpenters, and Sampson, Clark & Co., masons; cost, $150,000.

Cincinnati, O.—Messrs. Jones Bros. & Co. have let contracts for building a five-story printing house, 48'x80'; cost, $20,000; Mr. Chas. Crapsey, architect.

Bids have been received by the Supervising Architect for the court-yard, roof and ceiling of the Custom-house as follows: Snead & Co., iron works, $51,389; Haught, Peckham & Co., $57,308; Henvel, Man & Co., $82,538; and Mr. Clements, three bids, the lowest, $84,565.

St. John, N. B.—The Albany (N. Y.) Architectural Iron Works have received the contract for all of the iron-work to be used in the construction of five large buildings to be erected here.

Hartford, Conn.—The county commissioners have decided to call for no bids for erecting the new county building, but the work will be done by Messrs. John R. Hills and John C. Mead, under the direct supervision of the commissioners, all purchases and expenditures to be made by them.

Government Contracts Let.—Bids were opened June 20, in the War Department, for furnishing a hydraulic ash lift or elevator for the north wing of the State, War and Navy Department building. The bidders were: Eli Thayer, Philadelphia, $1,200; Ferrill & Mickle, Philadelphia, $1,335.50; Stokes & Parish, Philadelphia, $1,275; George C. Howard, Philadelphia, $700; Snowden & Cowman, Baltimore, $1,262; Otis Bros. & Co., New York, $1,100; Granville Hydraulic Elevator Co., N. Y., $1,875, and Whittier Machine Co., Boston, $1,063.

Levee Contract Let.—Contracts for the Lewiston levee, in Columbia County, Wis., have been let to local bidders at 13 $\frac{7}{10}$ cents per yard, including sodding.

Building Contract Let.—The contract for the erection an extension to the capitol at Madison, Wis., has been awarded to Janesville parties for $188,370.

BUILDINGS.

New Church.—Danville, Ill., is to have a $20,000 church.

The New Hotel building at Peoria, Ill., will cost $130,000.

Plan for Church Accepted.—A dispatch from Holyoke, Mass., says: The building committee of the Second Congregational Church have finally decided to accept the plans of Architect Kilburn, of New York, and a contract has been forwarded to him. The expense of the building is not fully known.

Some thirty buildings are now going up in Pensacola, Fla., to cost $300,000.

Fostoria, O., is to have a railway spike factory, to employ two hundred men.

Galveston, Texas, wants a grain elevator.

Watertown, Mass., will erect a public library building, to cost not more than $30,000.

School-Houses.—Lexington, Ill., has determined to build two brick school-houses this summer, one costing $3,000 and one $2,000.

Toledo, O.—There has been nothing flattering to chronicle regarding building matters in Toledo nor its vicinity, so far as '82 can yet show.

The bulk of work has been a very cheap class of cottages and a few "pasteboard" store buildings. Yet carpenters are not plenty: certainly *skilled* workmen never seemed more scarce. But of botches, or, more properly, poor, ignorant men who never learned a trade, and who are never surprised at being "shipped" at any hour in the day, and whose "kit" is a dull hatchet and a bent square, there are a plenty; indeed a surfeit. Pitiable indeed the position of the poor architect who so far forgets himself as to consent to superintend a piece of work for an owner so deluded as to believe that the buildings will be produced to him "according to plans and specifications," or that such a thing is possible under the present régime.

Building material is rather high still, and will probably so rule. Some have concluded to defer building till there's a decline, which can't come unless it is wished to repeat the horrors of '73 to '80. The fact is, the prices now are healthy, where before they were far the other way. All will come right in time.—*American Architect.*

LABOR.

Wages of Brickmakers in Chicago.—About 3,600 brickmakers who recently obtained an advance of 12½ cents a day have notified their employers that they will demand a further increase of 12½ cents.

BRIDGES.

The Georgia Railroad bridge at Athens will be the highest in the State.

Drawbridge Over the Passaic River.—This bridge was built by the authorities of Hudson and Essex counties, New Jersey, over the Passaic River on the line of the turnpike between Jersey City and Newark. The draw is 180 ft., with two spans of 170 ft. each. The bridge is of iron and was built by the Wallis Iron Works, of Jersey City, N. J.

A Bridge Rumor.—St. Louis, June 18.—It is stated, on what is deemed good authority, that the visit here last week of President Roberts and other officials of the Pennsylvania Railroad was in part, at least, connected with a new scheme of no less magnitude than the building of another bridge accross the Mississippi River at this point. It is said while these officials were here they were in close consultation with the officials of the other roads, and that the bridge project was freely discussed. The scheme embraces the Pennsylvanie company, the Baltimore & Ohio, the Chicago & Alton, and the Indianapolis & St. Louis, and the project is to build a bridge a little north of the city at a point known as the Chain of Rocks, where a good foundation for piers can be obtained at very moderate expense. The proposition has been talked of before, but it is said to have taken a more definite shape this time than on any previous occasion.

Bridging the Rideau River.—The bridges of the Canada Atlantic Railroad over the Rideau River and Rideau Canal are about ready for the iron superstructure, and work will be commenced next week by the Toronto Bridge Company, who have a contract for this part of the work.

Bridges Swept Away.—Cincinnati, O., June 15.—The storm last night prostrated four bridges on the Cincinnati, Indianapolis, Chicago & St. Louis Railway, between Guilford and Indianapolis. The Little Miami Railway track has been under water for a short time at various points, but no detention of trains is reported. The Ohio & Mississippi Railway is running to St. Louis on schedule time. The telegraph wires on the Big Four between here and Indianapolis, are down.

CORRESPONDENCE.

RELOCATION OF RAILROADS.

SPRINGFIELD, Mass., June 22, 1882.

EDITOR ENGINEERING NEWS:

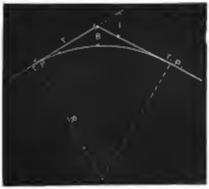
"Engineer," in your paper of June 17, wishes to obtain the most feasible method of making a relocation of a railroad under the rules of the Railroad Commissioner of Massachusetts. Having been engaged more or less for two years in relocating a portion of a double-track road in Massachusetts under said rules, and at present relocating a 17 mile single track branch of same road, I venture to give a few points as found in my experience, particularly the establishing of a satisfactory center line, hoping some may apply to his case. I have always found that the greatest trouble lies in relocating the curves on account of the many compounds in them caused by their being pulled more or less from the original position, and have generally used one of three methods in their alignment. A curve under 800 ft. in length and allowing an intersection of the tangents would often run in by use of rule found in Henck's field book, article 70. By measuring from the point of intersection of the tangents *C* to the center of the track, if such is the center line, and calling this distance *b*, then *T* = tangent and *I* = angle of intersection; $T = b$ cot. $\frac{1}{4}$ *I*. This method will seldom work on long curves, unless they be very flat. Another method I have often found convenient for locating a point from which to run the curve, knowing the radius that was originally used, is as follows: Produce the tangent to some point, *A*, say two or three hundred feet beyond the apparent tangent point, and measure *A B* to the center, then the formula for calculating middle ordinates of a curve

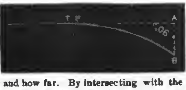
$$m = \frac{C^2}{8R}$$

will be found of sufficient accuracy to locate the tangent point. Let $A B = m$, then

$$C = \sqrt{8Rm}.$$

By measuring back from *A* a distance equal to ½ c., a point will be located from which may be run considerable of the curve. A great majority of the curves, however, that I have had dealings with could not be located by the above methods, so that I have been obliged to resort to the last of these three cases spoken of. I would measure off the curve into stations of 100 ft., and set up at these stations, in the center of the track, stakes or pegs that could be easily seen. I then set the transit at a station, either about midway of the curve or at some place where there was an apparent point of compound curvature, then by taking angles to the stakes at the stations, could quickly determine what curves could be run each way and how far. By intersecting with the tangents from this point a very long curve can sometimes be run with only one compound. The reason that curves locate better from a point near the middle than from the ends is owing to the tendency of trackmen to lengthen the curves in lining the track, leaving all but three or four hundred feet of each end more nearly where it was originally laid.





Having decided on the location of the center, the widths taken in the original location as shown by the deeds can be located in reference to the new center. This is all a matter of common surveying, its simplicity depending on the data at hand. In the work which I have had in this line the deeds gave the widths taken at each station, and the problem has been to find these stations. Having notes showing where the old division lines crossed the center line I have in all cases used such of them as could be found remaining as a basis for finding the old stations. I would then transfer these stations to the new location, thus giving the proper widths at the points as originally located.

Yours very truly, C. E. ALGER.

RAILROADING IN THE FAR WEST.

SUGAR LOAF, Col., June 19, 1882.

EDITOR ENGINEERING NEWS:

I have been using your new profile book, and like it exceedingly. It is the best in idea and execution I have met with: plate and paper are both very good, and far clearer to the eye than the Queen papers are of late. If a friendly suggestion would not be misunderstood, I would propose what seems to me to be an improvement on it: Add one or two stations in length to the outside of the plate at each end, keeping the heavy tenth station lines in their present position. It is often desirable to see a fill and the cut that is to make it both at the same time. If the grade point comes at the end of a page in your book, this is impossible without skipping a full ten stations or bringing odd stations on the 10th station lines. My suggestion would repeat 300 or 400 on each end of each page, and in 99 cases out of 100 serve all the purposes of the roll or continuous book, and do away with the liability to be torn by the wind when under examination. Another point of change, which might not prove on the whole an advantage, would be the widening of the plate. I am building a line, with a maximum grade of 4.50 per station, a rise of grade line of 135 per page, and in heavy work my line crosses the page three times in the 3,000'. The addition of say 25' in width could be made with an addition of almost nothing to the width of the book, and at any rate keep it smaller than many of our field books, and would adapt your profile book to most of the heavy work which of late years bears a respectable proportion to the whole of the railroad construction of the country. Will you ask through your paper for any practical information as to expansion of rock in going from cuts into embankments with any data accessible. There has arisen a question on the subject here. I have used a number of tests but would like further light on the subject. The grading of the first 20 miles of this line will be completed and the bridges will be put in at once. Labor is plenty but little or no demand in Colorado. Laborers receive $1.75 to $2.00, Rockmen, $2.25 to $2.50, Teams, $3.00 to $4.00, and there are twenty men to take the place of one. Engineers are a drug in the market; probably from 50 to 75 are in Denver to-day out of employment and with little prospect of getting any. Last year anything that could look through an instrument, was in charge of work and to-day they are all out; eastern men don't want to come out here just now; I have never seen engineers so badly off for work as this season.

Yours respectfully,

Asst. Eng. U. P. R'y.

CALCULATING "OVER-HAUL."

ST. GEORGE, N. B., June 21, 1882.

EDITOR ENGINEERING NEWS:

In regard to calculating over-haul, our method is as follows: Calculate the quantities in both excavation and embankment, and enter them on the profile in detail; then, by inspection, see approximately how far the center of gravity of each quantity of excavation will have to be moved to make its share of the embankment. Multiply the quantity by its distance in feet moved, proceed with the next the same, and so on until the excavation is completed, take the sum of all these products and divide the amount by the total quantity moved. The result will be the total haul; from this take the limited haul, in this case 1,000 ft., and the remainder will be the over-haul, this multiplied by ($0.c.) and divided by 100 ft. will give the number of cents per cubic yard extra that should be paid for moving the whole excavation. You will perhaps notice this is a practical approximation by Rankine's formula for center of gravity, case VI., page 158, Civil engineering, 7th edition, 1871. F. W. H.

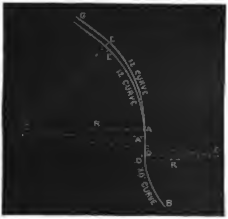
LOCATING CURVES.

PITTSBURGH, Pa., June 21, 1882.

EDITOR ENGINEERING NEWS:

The tenth line from the end of my answer on page 202 should read, "*X X* multiplied by $\frac{1}{10}$ gives," etc.

The following is a graphical solution of "A Subscriber's" problem published last week: Let *B D* be the 20° curve, *D A* the 100-ft. tangent and *A E* the 12° curve. With center *C* describe an arc *C' C''* through *C*. Find its intersection, *C'*, with a line parallel to and 478.8 + 25 ft. from the tangent *E G*. This is the center of the required curve (*A E*). Draw *C C'* and lay off the angle *C C' A'* = angle whose tangent is 100 ÷ (*R* + *R*). *A'* (distant *R* from *C'*) is the required *P C* and *D'*, 100 ft. from *A'*, is the new P. T. of the 20° curve.



Plotting this on a scale of 40 ft. to the inch I find *D D'* = 11.8 ft. ALPHA.

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LOCATING CURVES.

LEWISTON, Ill., June 21, 1882.

EDITOR ENGINEERING NEWS:

In answer to inquiry by "A Subscriber" in your issue of June 17, I suggest the following method as giving a very close approximate result. It is apparent that some number of degrees should be "thrown off" from each angle.

Now, the tangent length of a 20° curve for an angle of 60° = 166.24', and that of a 12° curve for an angle of 48° = 212.97'. Then the total distance between points of intersection equals 166.24' × 212.97' × 100' = 279.21'. From this amont deduct 25' leaving 254.21' for such distance when the 12° curve is made to terminate in the new tangent to left. Now suppose that we diminish each original tangent distance by portions inversely proportional to their respective degrees of curvature, viz.: 12 : 20 : : 9.38' (nearly): 15.62' + whence 166.24' — 9.38' = 156.86' × = Tangent distance of a 20° curve for an angle of 57° — 10 (nearly); and 212.97' — 15.62 197.35' = Tangent distance of a 12° curve for an angle of 44° 50'. Difference between these two angles is too great by 20'. If the one be increased and the other diminished 10'; we then have 57° and 45° respectively. Tangent distance of former = 156.88' and of latter 198.18', which with the intervening 100' make 454.46' for distance between points of intersection and differing from that required (254.21') as already shown by ¼ ft. and therefore leaving the tangent between curves 100.25'. Yours truly.

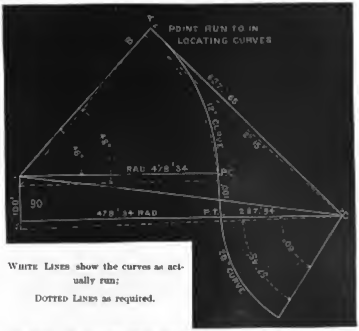
ANOTHER SUBCRIBER.

LOCATING CURVES.

CLEVELAND, O., June 23, 1882.

EDITOR ENGINEERING NEWS:

In your issue of June 17 "A Subscriber" asks, how many degrees must be "thrown off" the 20° curve, so as to correspond with the case in question. *Answer:* 2° 14' 48", or in round figures 2° 15', *i. e.*, the 20° curve will only contain an arc of 57° 45' instead of 60°.



WHITE LINES show the curves as actually run;

DOTTED LINES as required.

The rule to be applied to this case and to similar ones is as follows: Calculate distance *A C* (see diagram), thence find angle at the center of a circle, with radius = *A C*, subtended by a chord = *A B*; this angle gives the number of degrees to be "thrown off" the first curve. This solution of the problem admits of a very nice graphical demonstration, by drawing a diagram of the case on paper and a copy of same on tracing cloth, thence fastening a pin through both at *C*, as a common center, and swinging the tracing over diagram, until line *A C* on tracing goes through point *B* of diagram on paper.

OTTO DERCUM,
Ass't City Civil Eng.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES. M. AM. SOC. C. E.

(*Continued from page 209.*)

CCCXLIV.—WESTBOROUGH.

Westborough, Massachusetts, in lat. 42° 17' N., long. 61° 37' W., is on a small tributary of the Sudbury River, on uneven ground.

Settled about 1700 it was incorporated as a town in 1717.

Water-works were built by the town in 1878, after plans of C. H. Pierce, taking the supply from Sandra Pond, which receives the drainage of about one square mile. The pond is 2 miles from the centre of the town and 134 ft. above it. An old mill dam, which on examination proved to have been built of rocks and gravel dumped on the natural surface, was strengthened by building a stone wall laid in cement and formed in a trench dug on the lower face of the old work. This wall is 302 ft. long and from 4½ to 11 ft. high. It is 3 ft. wide from bottom to within 5 ft. of the top, and then battered on both sides to the top, which is 2 ft. wide. It was covered on both sides and for 2 ft. over the top with earth and gravel. On the east side of the pond a dam was built across a bay. The heart of this was of puddled clay, and is 105½ ft. long. For 89 ft. it rests on quicksand, through the centre of which a row of sheet piling was driven. Another dam across a ravine was built of gravel and loam and faced with a stone masonry wall 40 ft. long and 6 ft. high, built on a semi-circle and used as a waste-way for surplus water. The reservoir covers about 50 acres and affords storage for 45,000,000 gallons. From a gate-house of brick the water is conveyed to the town by a 12-in. cast-iron pipe for 8,435 ft. The distribution is by 3¼ miles of cast-iron pipe of from 12 to 4-in. diameter, with 57 fire hydrants, 25 gates and 366 taps. Forty metres are in use.

The town pays $25 per year for each hydrant.

Service pipes are of wrought-iron.

The population in 1880 was 5,214. The consumption is not known.

The works have cost $53,000, the amount of bonded debt at 5 per cent.

The expenses in 1881 were $1,786.27, and the receipts from water rents $3,119.12, and from the town and other sources $3,348.12.

The works are managed by three Commissioners, one being elected each year. W. R. Gould is Clerk to the Board.

CCCXLV.—PLAINWELL.

Plainwell, Michigan, in lat. 42° 27' N., long. 85° 30' W., is on nearly level ground on the Kalamazoo River. Settled in 1860, it was incorporated in 1868. Water-works were built by the village in 1870 for fire protection only, taking the supply from the river, and pumping directly into the mains by water power driving a Holly rotary pump. There is one mile of 6 and 4-in. cast-iron pipe, with 6 fire hydrants and 3 taps.

The population in 1880 was 1,402.

The works cost about $4,000, and the cost of maintenance is merely nominal. J. Sternberg is the Superintendent, under direction of J. P. Hitchcock, the Chief of the Fire Department.

CCCXLVI.—WILMINGTON, N. C.

Wilmington, North Carolina, in lat. 34° 11' N., long. 78° 10' W., is on a bluff on the east bank of Cape Fear River, at the head of navigation.

It was settled about 1750. Water-works were built in 1881 by J. A. Cloud, for a private company, taking the supply from the N. E. branch of Cape Fear River, and pumping by a Worthington compound duplex engine of steam cylinders of 12 and 18½-in. diameter, and water cylinder of 12-in. diameter and 10-in. stroke, with an auxiliary high-pressure engine of 14-in. steam, and 8½-in. water cylinders and 10-in. stroke, lifting the water 185 ft. into a stand-pipe 20 ft. in diameter and 80 ft. high.

Distribution is by 12 miles of cast-iron pipe of 12 to 4-in. diameter, with 100 fire hydrants and 80 gates. The number of taps is not given. The city pays $75 per year for each hydrant. The population in 1880 was 17,361. The consumption is not stated. Service pipes are of wrought iron. The works cost $150,000. The bonded debt is $80,000 at 6 per cent. interest.

No other financial statements are given, the works having just gone into operation.

CCCXLVII.—SALAMANCA.

Salamanca, New York, in lat. 42° 10' N., long. 78° 46' W., is on the Allegheny River, on hilly ground. Water-works were built by a private company in 1881, taking the supply from a spring brook, the water of which is impounded in a reservoir holding 3,000,000 gallons, half a mile from the town and 150 ft. above it. Distribution is by 3 miles of cast-iron pipe of from 10 to 4-in. diameter.

There are 40 taps. The population in 1880 was 2,800. The number of hydrants and any financial statistics are not furnished. H. O. Wait is the Secretary.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From W. R. Gould, Clerk of Water Board, statistics and set of reports of the water-works of Westboro, Mass. From J. B. Cook, Secretary Halcyon Hose Company, statistics of water-works of Plainwell, Mich. From J. A. Cloud, partial statistics of the water-works of Belvidere, N. J., and Wilmington, N. C.

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SURFACE RAILROAD BILL VETOED.

ALBANY, June 28.—The Governor has vetoed the bill to provide for the construction, maintenance and operation of street railroads in cities, villages and towns, known as the Surface Railroad bill. His reasons for not approving the bill are as follows:

STATE OF NEW YORK, EXECUTIVE CHAMBER,
ALBANY, June 28, 1882.

Whatever merit of a general character this bill possesses, it seems to be outweighed by objections made by the Mayor and Controller as well as by the citizens of the City of New York, who claim that the public interests of that City are not sufficiently protected from abuse. The third section of the bill provides that the local authorities of the City of New York shall not consent to the construction of any surface railways in said City without receiving payment into the treasury of such consideration as said authorities shall determine; nor shall they consent to the location of a surface railway in Broadway from the Battery to Fourteenth street without first securing payment to the city treasury of a bonus of at least $750,000, and such additional consideration as said authorities may see fit to prescribe. During the last 30 years immense private fortunes have been accumulated from street railway franchises in the city of New York which, owing to inconsiderate legislation, have been granted without adequate compensation to the city. Had there been incorporated into the laws authorizing these grants suitable provisions for securing to the city a portion at least of their ultimate value, New York would now realize a revenue from such a source that would largely diminish the burden of taxation imposed to defray the expenses of its government. The future growth of the metropolis will make many franchises hereafter granted very valuable, and hence, profiting by unmistakable errors in past legislation, subsequent laws should securely provide for the payment into the city treasury of a reasonable percentage on gross receipts, or, instead thereof, should provide for reduced charges of fare in order that the people shall obtain direct benefit from the appreciated value of the respective franchises.

Two distinct objections may be stated to the provision of this bill authorizing the local authorities that grant the use of streets to fix the rate of compensation for the same:

1. The money value of these railroad franchises cannot well be estimated in advance. It remains an unknown quantity until determined by a practical method of fixing a percentage on the earnings or gross receipts. This principle should be established by law and not left to the option of the Common Council.

2. Experience has demonstrated in repeated instances that the Common Council of a great city is not the safe custodian of such interests and authority as proposed in this bill. It has happened often that selfish considerations have intervened and controlled the action of such body to the manifest detriment of the public welfare. The fact that this is a general measure, which, if enacted, would become the fixed law relative to street railway franchises, and the conferring on the Common Council of New York City authority to determine the rate of compensation in such cases, renders it a matter of more than ordinary concern.

ALONZO B. CORNELL.

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THE THRUST OF EARTHWORK.*

The author remarks that the number of articles inserted in the "Annales" on the thrust of earthwork and on retaining walls would seem to show that the solutions indicated have not attained the necessary degree of clearness for easy remembrance and application to practical cases. This he attempts to realize in the present note. Surcharged quay walls are treated on, but the case most often presenting itself in the works of the "Ponts et Chaussées" is that of a simple retaining wall, supporting earth with a level surface, and the results of his calculations for such cases he claims can be easily remembered. The earthworks having a slope of repose of 45°, he finds the thrust will be about ¼ that of water; while with a slope of 30° it will be $\frac{1}{12}$, and with one of 20° about ⅔ of the same. It is assumed that the earth is not surcharged, that its weight is 1.75 times that of water, and that it thrusts against a vertical-backed wall.[*]

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*Transactions of Institution of Civil Engineers, Vol. LXVIII.

The author calls attention to the important practical fact that the critical moment for many quay and dock walls is when the water subsides rapidly after a flood. To determine the slope of repose assumed by earth under such circumstances, M. Lagrené made experiments with a model, and found that the light earth used behind the lock walls at Menton, the slope assumed was 24 18, the weight of the wet earthwork being 1.86 times that of water. At St. Aubin, where the filling was gravelly, this slope was 30°, and the relative weight 1.8. At Notre Dame de la Gavenne the light earthwork slope was 35°, and relative weight 1.58. With gravel and sand mixed, the slope was 30°, and weight 2.15, and with the sand of the island of Mucchauette the slope was 36° 4', and the relative weight 1.534. These variations, the author says, show that the choice of earthwork filling behind lock and quay walls is a matter of importance.

B. B.

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THE WATER SUPPLY OF VENICE.

Venice, a city of 130,000 inhabitants, with factories and a naval station, has been notorious for its defective supply of water of bad quality, even since the construction of artesian wells in the last forty years.

In 1868 two proposals were made to the municipality, one by Engineer Silvestri, to bring a supply from the Sile at Canizzano, the other by a Belgian company to bring water from the Breuta, in both cases through a conduit along the railway. In 1875, five more projects were submitted, one of which, a combined proposal of civil engineers. Ritterbandt, Dalgarius, and Ponti was accepted. Arrangements for carrying out this work were made in 1879 with a French construction company; the terms of concession being a rate of nearly 1s. 5d. per 100 cubic feet delivered at a height of 164 feet above ground level, a minimum daily supply of 197,180 cubic feet, a storage of 3,530,000 cubic feet, and a duration of concession of sixty years. Finally, some improvements and general modifications suggested by Engineer Fumico were adopted with further alteration, and the works were carried out in general accordance with them by the Societa Veneta.

The supply was taken from the Breuta, above a dam at Stra, and conducted by a channel to the bed of the Seriola, and thence to the filter beds of Moranzani; the supply is 53 cu. ft. per second; but it is proposed to obtain a further quantity from a point higher up the stream. The four filter beds have an aggregate surface of 12,500 sq. ft., the filtering materials being pebbles, gravel and sand, and the surrounding walls being carefully constructed to prevent saline infiltration from the adjoining salt marshes. The filter beds also act simply as reservoirs when the Seriola water is so pure as not to require filtration. Adjoining the filters is the pumping-station, where pumps driven by a turbine raise the filtered water into a collecting reservoir. From this the water is taken in pipes of 2.8 ft. diameter under the lagoons and salt marshes for a distance of about 8¼ miles to Venice. The pipes were laid by means of coffer-dams, the beds being pumped dry, and the pipes generally laid in a concrete trench in the bed of the lagoon. At passages under deep channels and canals, that frequently occurred in these lagoons, special inverted syphons were employed, and a syphon crossing over a bridge in the town was also constructed. The pipes were ordinary cast-iron socket pipes, with lead joints, made by the Societá di Marquise and di Terni, weighing in all about 2,550 tons. The reservoir at Venice is built on piles, vaulted and covered with earth; it holds 3,530,000 cu. ft. of water.

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A VENETIAN CONSTRUCTION COMPANY.[†]

This large folio, containing 160 pages of text and seventy plates, gives a detailed account of the more important operations of the Venetian Society in contracts for public works and buildings during the past decade. The society was founded at Padua in 1872 with a capital of 10 million lire, the original syndicate being composed of Messrs. Breda, Forti and Sacchetto, and the shareholders being about thirty-four in number, mostly Italians. The works and buildings undertaken during the decade were: In 1872, Cemetery of Venice, Finance Office at Rome; in 1873, improvement of the banks of the Po, Piave Bridge, improvement of the Venetian lagoons; in 1874, Legnago-Rovigo Railway, Vicenza-Schio Railway, ship-building slips; in 1875, docks at Venice, railways, Vicenza-Treviso and Padua-Bassano, street widening at Treviso; in 1876, St. Martha Quay; in 1877, Genoa Harbor, Fort Aurelio; in 1878, Aonegliano-Vittorio Railway, buildings on the Esquiline; in 1879, Fort Braschi, deepening of the ports, roadsteads, and shores of the province of Naples; in 1880, aqueducts of Vittorio and of Venice, town hall of Vittorio, harbors of Palermo and Licata, maintenance of the Genoa Harbor, and the foreshore of San Pierdarena; in 1881, Mestre-San Michele del Quarto Railway, Benevento-Avellino Railway, Monvalle-Laveno Railway.

In addition to these there were other works in the construction of which the society participated. The profits of the shareholders during this period were 6 per cent. per annum for the first three years, 8 per cent. for the next two years and 12 per cent. in 1878 and 1879; thus showing that the advantages of the society comprise permanence of character as well as direct financial profit, besides conducing to national improvement.

This large volume does not, however, give accounts of all the works undertaken by the society, but merely of some of the more important ones. These are: 1. The Roman Finance Office. 2. The Buildings on the Esquiline. 3. Genoa Harbor. 4. Venetian Cemetery. 5. Venetian Dockyard. 6. Railways within the Province of Venice. 7. Hospital train. 8. The water supply of Venice. The accounts of these are profusely illustrated both by plans, sections and elevations and by artistic drawings.

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PILE FOUNDATIONS AND PILE-DRIVING FORMULÆ.

[FROM A CIRCULAR OF THE OFFICE OF CHIEF OF ENGINEERS, U. S. A.]

The above valuable paper is also published in full in Van Nostrand's Engineering Magazine for July. The conclusions arrived at are as follows:

1st. Pile-driving formulæ should be accompanied by tables of factors of safety, corresponding to all the common and easily recognizable kinds of soil.

2d. These factors of safety should be determined on after extended experiments on the supporting power of piles, although approximate factors, which could be used without hazard, could be found from examinations of the records of the driving of the piles of actual foundations, provided the weights of the superstructures are known and descriptions of the soils have been preserved, and provided also that the foundations have carried their loads during sufficient lengths of time.

3d. In experiments on the supporting power of piles, the loads should not rest upon single isolated piles, but they should cover a number of piles driven at those distances apart which are usual in pile foundations.

4th. In every case of construction of a pile foundation, the record of the driving of the piles should include such a description of the soil obtained for borings as would enable an engineer having to found a work in a similar soil to recognize it.

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ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

At the meeting of the Society held on June 21, a paper by O. Chanute, member Am. Soc. C. E., subject, "Uniformity of Railway Rolling Stock," was read and discussed. A meeting of the Society will be held July 5, 1882. The succeeding meeting will be September 6, 1882.

ENGINEERS' CLUB OF PHILADELPHIA.

RECORD OF REGULAR MEETING, June 17th, 1882.

President Rudolph Hering in the chair. Nineteen members and two visitors present.

Mr. John T. Boyd described a Shrinking Gauge, which was designed by Mr. Brown, General Foreman of the Works of the Hartford Engineering Co., and enables the average lathe hand to make the "shrinking fits," instead of placing the latter in the hands of one or two first-class machinists in the establishment, which is probably the practice in the majority of machine-shops throughout the country. The gauge resembles, in miniature, an arm-swivel for a tension-rod, in which one of the bolt-ends contains a fine thread screw. The three screws have each a milled head jamb-nut, to maintain them in position when adjusted.

To use the guage, the diameter of the hole in the wheel-hub, collar, coupling, or lever-boss, as the case may be, is first obtained by bringing the inside ends of the large screws in contact, and locking them securely with their respective jamb-nuts; then running the fine-thread screw out until it calipers or gauges the required distance; finally locking the last named screw.

One of the large screws is now unlocked and moved away from the other a distance determined by placing between the inside points of the large screws, and jambing the same, a thin strip of metal, which is in reality the measure of the shrinkage or the difference by which the diameter of the shaft is to be greater than the diameter of the hole. The proportion by which these differences are made is obtained by experiment only and varies with the sizes and materials.

The gauge is well made of steel, hardened where necessary, is light and easy to use and has a complete set of shrink measures, properly marked, for different diameters of shafts.

Mr. Geo. Burnham, Jr., described a wood screw in which the thread, instead of being cut, is formed by passing the blank through a series of rolling, working against stationary, dies. The first set forms a slight ridge only, the second deepens it and so on until a perfect thread is formed. The thread of the finished screw is slightly larger in its outside diameter than the unthreaded neck of the screw, and the point is turned conical and left unthreaded, thus differing from the ordinary cut screw, in which the thread continues to the extreme point. The object of this construction is to adapt the screw to the present mode of using it in soft woods: that is, driving it part way home before using the screwdriver. Bolts are also made in the same way, the thread appearing to the eye as perfect as a cut thread. It is claimed that a bolt made in this way is ten per cent. stronger in the thread than a cut bolt.

Mr. Wm. A. Ingham made some remarks upon experiments in jigging ore. After premising that there are two classes of jigging machines—one in which the tray with the ore is moved up and down under water, the other in which the tray is fixed and the water is forced up and down through the ore bed—he proceeded to comment upon the difficulty he had experienced in obtaining from the books fixed data for the construction of a jig of the second class. He found that great variations prevailed in the practice at different concentrating works. The speeds of the water piston ranged from 48 to 200 per minute and the stroke from 4 in. to ½ in. There were similar variations in the sizes of the particles operated on, in the length of the screen, in the degree of the inclination of the bed, and in fact the best practice varied at every point.

In the face of such diversities, he was obliged to construct his jig with all its parts adjustable, and determine for himself by a series of trials the conditions best adapted for his work. He soon found that, the other parts remaining fixed, the results could be varied as required by merely varying the piston speed and stroke, and that a high speed was necessarily connected with a short stroke and vice versa. He concluded by promising to prepare a paper on the subject at some future day.

The following Report was presented:

The Committie of Award of "the Prize offered by a Member of the Club, May, 1881," beg leave to report that they have carefully considered the papers submitted for competition, and have awarded the prize of $50.00 for the paper upon a subject strictly in Mechanical Engineering: to Mr. Wilfred Lewis, of Philadelphia, for his paper on the "Application of Logarithms to Problems in Gearing;" and $50.00 for the paper upon a subject of Civil Engineering, to Mr. P. A. Baermann, of West Troy, N. Y., for his paper on "What Thickness of Metal Should Be Given to Cast Iron Pipes Under Pressure;" these being the two papers which, in the judgment of your Committee, conformed the most nearly to the requirements indicated by the Rules heretofore published for the guidance of the Committee. All of which is respectfully submitted.

FRED. GRAFF, *Chairman*.
GEO. BURNHAM, Jr.
HENRY G. MORRIS.
HOWARD MURPHY,
Secretary and Treasurer.

◆

TUNNEL UNDER THE BOSTON MOUNTAIN.—FAYETTEVILLE, Ark., June 24.—At 5 o'clock this morning the workmen of the two ends of the tunnel under the Boston Mountain, 23 miles south of this city, on the line of the St. Louis & San Francisco Railway, shook hands through the division wall. A few minutes later Mr. McDonald, the superintendent of the tunnel works, under the charge of Cameron & Holly, Col. Cameron, and Capt. Hinckley, division superintendent, passed through the aperture made by the completing blows of the workmen. Track will be completed through the tunnel in two weeks. This is the finishing stroke on the St. Louis and great Southwestern thoroughfare. The hole is 1,730 ft. in length, and is the most important work of the kind in the State. The big bridge, 800 ft. long and 123 ft. high, just south of the Boston Mountain, is also about completed. Trains from St. Louis to Fort Smith, by way of the 'Frisco, will run on the 15th of August next.

BEARING PILES: Formulæ for their Sustaining Power, Size and Disposition in any Foundation. Compiled by Rudolph Hering, Mem. A. S. C. E. Price 20 cents. Is a neat and valuable pamphlet devoted to the above subject. For sale only at this office.

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[*] It may be remarked that these results are based upon what was termed in a recent paper on the "Actual Lateral Pressure of Earthwork" (Vol. LXV.) the "ordinary theory," and that they are not corroborated by the results of actual experiment. The criticism of the paper referred to by Continental engineers would lead to the inference that the "ordinary theory" was no longer acted upon on the Continent, but the above note by an engineer-in-chief of the Ponts et Chaussées would appear to lead to an opposite conclusion. —B. B.

[†] *La Società Veneta, per Imprese e Costruzione Pubbliche* 1872-1881. Bassano: Roberti.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.

S. D. V. BURR..............ASSOCIATE EDITOR.

SATURDAY, JULY 1, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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DRAWING INSTRUMENTS, how to use them and how to take care of them; and Some Difficult Problems in Carpentry and Joinery, simplified and solved by the aid of the carpenters' steel square, are Nos. 4 and 5 of Work Manual, issued by the Industrial Publication Company, 49 Maiden Lane, N. Y. Price of each 25 cents.

THE JOHNS HOPKINS UNIVERSITY CIRCULAR is a publication issued monthly by Messrs. John Murphy & Co., 182 W. Baltimore St., Baltimore, at the low rate of five cents each. They are well-condensed abstracts of valuable papers on various subjects, and also give the university meetings, etc.

COMBINATION BRIDGES; Their Merits and Their Cost—A Comparison with Howe Truss Bridges, is the name of an excellent illustrated paper read before the Engineers' Society of Western Pennsylvania, April 18, 1882, by C. L. Strobel, C. E., of the Keystone Bridge Co., and which is published in full in the *American Engineer* of last week and this. The address of our esteemed contemporary is 182 Dearborn St., Chicago.

VAN NOSTRAND'S ENGINEERING MAGAZINE for July has an original paper by Prof. C. M. Woodward, anthor of the "History of the St. Louis Bridge, or the Basin and Regimen of the Mississippi River," and "Curves and Crossings for Railways," by Prof. S. W. Robinson, of the Ohio State University, Columbus, O. Prof. Robinson has contributed an article on "Railway Economics," read at the annual meeting of the American Society of Mechanical Engineers, in 1881. This is a continuation of that article.

GOV. CORNELL evidently thinks that it is true that something should be paid for the valuable franchises that have heretofore been so liberally voted away to street car and other passenger-carrying companies in American cities, and especially in New York, where large fortunes have been made by the street railway and the ferry companies. We publish his veto of the Surface Railroad Bill elsewhere, and what he says may suggest similar ideas to the councils of other cities. Europeans do not give away these valuable franchises.

THERE is not a copy of "Rawlinson's Suggestions," or "Latham's Sanitary Engineering" (American edition) to be had in this city, and there is not much prospect of there ever being any more copies for sale. Judging from the run on "Greene's Bridges"—60-cent edition—the opportunity to secure this excellent book at this low price will also soon come to an end. We have only a very limited number of copies unsold. The exceedingly practical and simple method it treats of is too well known to be further commented on. The price is less than one-fourth of that of the complete book, while the contents cover the most important points. The price can be sent in currency or postage stamps, and the risk of loss is too slight to warrant the cost of registering, or of buying a money-order. When the small stock on hand is exhausted, the book is out of print, and the price of its successor is two dollars and fifty cents.

THE BROADWAY UNDERGROUND RAILROAD COMPANY.—A bond in the sum of $100,000 has been filed with Controller Campbell, of this city, by the owners of the charter for a Broadway underground railroad. According to the terms of the charter this sum will be forfeited unless a rapid transit underground railroad is completed from the Battery to Forty-second street within four years from the filing of the bond. The charter under which the company proposes to work was granted by the Legislature some ten years ago and is generally known as the Beach Pneumatic Tunnel.

The building of an underground railroad in this city has been most freely discussed for the past few years, but as yet nothing practical has resulted. The matter is now in the courts and, as far as can be leaned, the date for the commencing of actual work must be placed a long way in the future.

HUDSON RIVER TUNNEL.—Since the time of odr last visit to the tunnel, the work on both sides of the river has progressed most favorably, and shows a decided increase in the figures representing "completed work." The heading on the New York side has been advanced about 20 ft. further than when last noted. The material passed through being still sand and water, the work is, of course, prosecuted with great care, precautions being taken to guard against the liability of any mishap. There is yet required about 38 ft. of tunnel before the bulkhead wall will be passed.

On the New Jersey side the material still holds good, in fact being better adapted to the method of building than any yet met. The rate of progress is about 4 ft. per day, and the north tunnel has been completed for a distance of about 1,100 ft. from the shaft.

Messrs. Henry Bowie (who was Superintendent when the tunnel was built through the soft spots a short time since), and Chas. A. Haskins have the contract for furnishing all the required labor and superintendence.

WATER RATES, PROVIDENCE, R. I.—The Board of Public Works presented (June 6) a report to the Board of Aldermen in which they stated that, after mature deliberation and consultation with the Committee on Water, with reference to the subject of rates, they had come to the conclusion that any material reduction in the rates would probably increase the deficit of income, thereby increasing the rate of taxation. Should the Aldermen advise a reduction they would suggest the following schedule to go into effect, July 1 next: Where the consumption of water through a single tap amounts annually to $50 or less, per hundred gallons, 8c.; where the consumption of water exceeds in amount the sum of $50, annually, through a single tap, a discount of 10 per cent. on the excess over $50 up to $100 will be allowed and deducted from the amount due for the fourth quarter; on the excess of $100 up to $300 a discount of 20 per cent.; on the excess of $300 up to $500 a discount of 30 per cent.; on the excess of $500 up to $1,000, a discount of 40 per cent., and on all sums in excess of $1,000 a discount of 50 per cent.

A resolution was passed directing the Board of Public Work, to fix the water rates in accordance with the plan they had presented. It is estimated that this reduction, based upon the receipts of 1881, will amount to $20,000.

THE PANAMA CANAL.

Captain George E. Belknap, U. S. Navy, in a communication to Rear Admiral George B. Balch, commanding United States Naval Force, Pacific Station, from Callao Bay, Peru, under date of May 29, gives much valuable information in regard to the actual progress that has been made on the canal. A recent visit to Panama enabled the Captain to make extended inquiries, and in a trip to Aspinwall and back to personally inspect, as far as possible, what had been done since April, 1881, toward the work of excavation. In a conversation with the editor of the Panama *Star and Herald* the opinion was expressed that bad management and extravagant expenditure had characterized the canal officials who had also been unduly reticent in regard to their operations and intentions. This has been overcome, mostly by the fearless criticisms of the above named paper, and the public are in receipt of more varied and reliable statements than heretofore.

The sum of $200,000 has been paid for the Grand Hotel, which has been fitted up for offices at a cost of $30,000; some 200 officials, engineers, draughtsmen, clerks, etc., occupied the building, and yet still the accommodations were inadequate. On Ancoss Hill hospital buildings had been erected and grounds laid out at an expenditure of $200,000, and it was estimated that $800,000 would be required to complete them. The letter reports the editor as stating "that a similar extravagant expenditure had been made on the other side, and yet at no point on the Isthmus had the company a cot or bed of its own in which to put a single sick man." The buildings at Ancoss Hill are described as being built in the most substantial manner, and yet the writer was forced to the conclusion that if the expected sick of the canal employés were to be in proportion to the costly preparations made for them, "the Isthmus could not be regarded, what it is by many affirmed to be, a very healthy and salubrious region."

Mr. Boyd (Editor *Star and Herald*) was of the opinion that M. De Lesseps was far short in his estimates as to the total cost of the canal, and when asked if he believed that $500,000,000 would cut a working sea-level canal he gave no intimation that this amount was excessive. Notwithstanding all the engineering obstacles and climatic difficulties to be met, he was of the opinion that final success would crown the efforts being made.

An American business man of 34 years residence in Panama professed faith in the completion of the canal, but thought it would never reach that stage through the efforts of the present company, but "that the French company would probably reach Gatun with its cutting, when by that time, having exhausted its funds, it would collapse, and American capitalists would step in, take up the work and push it to completion."

The track of the canal has been cleared of trees and underbrush and staked out, and small gangs of men are working at Empire, Gatun and Monkey

Hill. The main work accomplished seemed to be the building of houses, probably for the officers. Although reported that the work of excavating the canal was in progress at Empire, Captain Belknap saw no result that would indicate it.

A steam excavator was working at a bank at Monkey Hill, the dirt being removed on a portable railroad to the mouth of Fox River, where a pier is being built with the intention of making a harbor that will afford safe anchorage at all seasons. At Aspinwall it was noticed that quantities of machinery and lumber and iron were laid along the shore with no protection whatever from the weather. The letter closes with the statement that "the company is still wrestling with the problem of the Chagres River, and what to do with it, as well as with regard to the terminal point of the canal in Panama Bay, although the outlook would not seem to be promising to those personally familiar with the Isthmus, its topography and climate, and the herculean obstacles to be overcome; and people having such knowledge and expecting returns for capital invested, will not be likely to put money in such an undertaking."

In a late issue of the San Francisco *Chronicle* we find an article on the canal purporting to be a report by a recent visitor, and which contains a description of the "Hercules" dredger mentioned in our article of June 17. The apparatus consists of an endless chain, the links of which are each 8 ft. long, about 100 ft. in length and extending from the top of the hopper—45 ft. above the water line—to the point of excavation. Thirty-eight iron buckets, with sharp ends for penetrating the material, are strung on this chain and their contents emptied into a discharge pipe, which is 3 ft. in diameter and 150 ft. long, laid with a pitch of 1 to 10. The excavated material is thus deposited 150 ft. from the center of the canal. Two steam pumps, with a capacity of 20,000 gallons per hour will be used when required to force water into the buckets as they arrive at the top, thereby facilitating the discharge of their loads. The boat is anchored on both sides. Passing through the boat, vertically, are two tubes 2 ft. in diameter, into which fit wooden "spuds" 60 ft. in length and furnished with cast-iron points or shoes weighing 1,800 pounds each. One of these at a time is driven into the mud at the bottom, thus firmly holding the boat. When the work has reached a certain stage on one side of the canal the spud is hauled up by tackle operated by steam and another driven. Thus the dredge, as it does its work, is moved laterally, gaining at each change of position, as a vessel would in tacking. It is stated that two tons of coal will operate the excavator for ten hours. One of these dredges, constructed at the cost of $5,000, and now at work building levees and digging a canal on the San Joaquin, has excavated 9,000 cubic yards of material in ten hours, and the average daily amount, including time lost in moving, is said to be about 5,000 cubic yards.

We quote briefly in regard to the plans of the contractors as follows:

> When these dredgers are set in position the contractors affirm that they will have the first excavation, a pass 100 ft. wide by 8 ft. deep, opened to Gatun, 8 miles from Aspinwall, by the 1st of March, 1883; the canal dug to its full width and depth to the same place by the 1st of October, 1883, and the balance of their contract of 7,863,600 cubic yards, including the work for the deviation of the Lower Chagres, by the 1st of August, 1884, provided, of course, that no accidents from the elements occur.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The May Transactions have been issued and delivered to members. Its 28 pages are entirely taken up by the annual address of President Ashbel Welch at the Washington Convention. Mr. Welch, although disavowing at the outset of his address "any general survey of the engineering field," yet has referred to very many, if not all, the principal engineering works now in process of construction. Under tunnels he refers to the St. Gothard, the Musconetcong, Hoosac, West Point, Bergen Ridge and also the proposed Dover Tunnel. The use of improved explosives, drilling and compressed air machinery are referred to in connection with these great undertakings in comparison with the methods in use in the early experiences of the author. Mr. Welch refers to great bridges, elevated railroads, the building elevator, steam heating, interoceanic canals and railroads for ships, and in connection with the canal question he favors the San Blas route. Railroad construction and its connection with the financial condition of the country is treated at some length, and the improvement of the Mississippi River with some of the hydraulic principles, the consideration of which may govern the action of the Commission, occupies several pages. The importance of good country highways is noticed and the author gives some interesting reminiscenses of canal engineering, on which subject he may well be considered an authority. Electricity; iron shipbuilding; the progress of the country as shown by the Post-Office departmental work; geological discovery; weather forecasts; sewerage systems; diamond drill; the life of iron and steel rails; the power and responsibility of corporations; uniform time; tests of metallic structures; checking of baggage, those and other subjects have received more or less notice. The address concludes as follows:

> What is, and is to be, the effect of all the activity and progress of the present day on human welfare? Doubtless the preponderance of effect is good, but with many drawbacks. I will notice one. The rapid movement of the business of the world requires an immense amount of brainwork to be done by those who direct it in each business day. This is made possible by the recently introduced facilities for rapid work. Formerly, when a man wrote his own letters, he thought sentences only as fast as he could write them. Now he dictates three or four sentences to his stenographer in the time he would have been writing one, and so performs three or four times as much brainwork per minute as he would if he wrote himself. He does not go out of his office to confer with a man in some other office, but sits still and telephones him. When the railroad officer travels on his own road he does not chat with his friends in the public car, but goes in his office car, with his stenographer, clerks, and table covered with papers. When a man goes home from his office he does not take the time to walk, but works on till the last moment, then goes on the elevated railroad. The brain gets no rest, as it would have got in old times; now constantly rushing forward, not standing in its tracks, as formerly, while the man was writing down the thought of the previous instant; now furiously at work, while the man was going from place to place. This kept up for six or eight hours a day must soon break a man down, and has already broken down some of our ablest men. It does not mend the matter much that next summer he can spend a few weeks at the shore, or among the mountains. A man running up hill till he is out of breath is not enabled to keep on running another hour by the prospect of rest next week. A man that runs a locomotive twenty miles an hour may run all day, but if he runs sixty miles per hour, and so his brain and eye have three times as much to do per hour, he must soon stop to rest.
>
> Undoubtedly the progress of the age, which is so largely engineering progress, does on the whole greatly increase the welfare of mankind. By making the forces of nature do the hard work, the labors of the toiling millions are enlightened many fold. The laboring man now works with brain and eye more than with muscle, and his business is now to apply some principle of science. This raises him intellectually. He now has time for improvement. Comfort and refinement, and even luxury, are brought within his reach. The forces of nature having become obedient to the will of man, they are made to produce for him not only plenty, but conveniences and luxuries formerly undreamt of. By the present facilities, the races of men are brought into contact with each other. Those races are being assimilated, and the prejudices and hatreds of the past are fading away. Supreme power among men is more than ever in the hands of the most enlightened, and they are sending civilization and Christianity into the regions most benighted. The light of Heaven is beginning to shine into the harem and the zenana. And the time seems to be hastening when there shall universally prevail "peace on earth" and "good will towards men."

The proceedings give in detail the work and amusements of the Convention at Washington, with a complete list of members there present. The Norman Medal for the past year was awarded to Mr. L. L. Buck, Mem. A. S. C. E., for his paper on "The Re-enforcement of the Anchorage and Renewal of the Suspended Superstructure of the Niagara R. R. Suspension Bridge." The following are the additions and changes since the last number issued: For members—Enrique Budge, Valparaiso, Chili; Robert Gordon, Henzada, British Burmah; Edward C. Kinney, Chief Engineer St. Louis, Des Moines & Northern R. R., Des Moines, Ia.; Gustav Lindenthal, C. E., Monongahela Bridge, Pittsburgh, Pa.; Thomas C. McCollom, C. E., U. S. N., New London, Conn.; Chas. P. Perkins (from Junior), Engineer P. & E. Div. P. R. R., Williamsport, Pa.; James L. Randolph, Chief Engineer B. & O. R. R., Camden Sta., Baltimore, Md.; David Reeves (from Junior), President Phœnix Iron Co., 410 Walnut street, Philadelphia, Pa.; Benjamin Rhodes, Niagara Falls, N. Y. Changes and corrections—Arthur and Leonard F. Beckwith, 75 Tribune Building, N. Y.; Cabell Breckinridge, Chief Engineer, Alabama Great Southern R. R., Tuscaloosa, Ala.; L. L. Buck, 124 Bedford ave., Brooklyn, N. Y.; S. H. Chittenden, East River, Conn.; E. L. Corthell, N. Y., W. S. & B. R. R., Mills Building, 15 Broad st., N. Y.; Wilson Crosby, 145 Temple Court., 5 Beekman st., N. Y.; C. W. Durham, 19 Fifth ave., N. Y.; Philip Golay, U. S. Assistant Engineer, Paducah, Ky.; Henry Harding, Salem, Mass.; Robt. L. Harris, care of Dr. David Kimball, Portsmouth, N. H.; Wm. M. Hughes, Engineer of Bridges, N. Y., C. & St. L. Ry., Hoyt Block, Cleveland, O.; Walter Katté, Chief Engineer N. Y., Ont. & W. Ry. and N. Y., W. S. & B. R. R., Mills Building, 15 Broad st., N. Y. City, N. Y.; Wm. H. Lotz, 57 Metropolitan Block, Chicago, Ill.; C. S. Masten, Div. Eng., W., St. L. & P. R. R., St. Louis, Mo.; James R. Maxwell, Chief Eng. & Supt. Cons. D., O. & O. R. Ry., Olney, Ill.; J. Albert Monroe, Div. Eng. N. Y., W. S. & B. R. R., Kingston, N. Y.; Charles E. Moore, Ass't Eng. W., St. L. & P. R. R., St. Louis, Mo.; Marshall Morris, Chief Eng. C. & I. Div. L., N. A. & C. Ry., 530 W. Walnut st., Louisville, Ky.; O. F. Nichols, Res. Eng. Henderson Bridge Co., Henderson, Ky.; Charles Paine, Gen. Man. N. Y., W. S. & B. R. R., Mills Building, 15 Broad st., N. Y. City, N. Y.; William D. Pickett, Fort Washaki, Wyoming; William Rotch, Treas. Connotton Valley Ry., 13 Exchange st., Boston, Mass.; J. Gardner Sanderson, Tribune Building, Room 77, N. Y. City, N. Y.; Clinton B. Sears, Capt. Corps of Engineers, U. S. A., Executive Officer Mississippi River Com., 2,828 Washington ave., St. Louis, Mo.; Horatio Seymour, Jr., Marquette, Mich.; José Tintorer y Gibergu, Asalto No. 12, Barcelona, Spain; Arthur M. Wellington, Ass't Gen. Man. Mexican Cent. R. R., No. 5 Plazuela de San Fernando, Mexico, Mex.; A. S. C. Wurtele, Ass't Eng. N. Y. C. & H. R. R. R., 60 Chestnut st., Albany, N. Y.; William A. G. Emonts, Sunbury, Northumberland Co., Pa.; Sandford Horton, Peekskill, N. Y.; Thomas Lafon, Sub. Div. Eng. Mex. Nat. Cons. Co., Manzanilla, Mex.; D. Jones Lucas, Lowellville, Mahoning Co., Ohio. Deaths—Gen. John G. Barnard, U. S. Engineer.

PERSONAL.

Mr. W. T. R. Fennessy is Chief Engineer of the new Hannibal, Terre Haute & Indianapolis Railroad.

Mr. E. H. Burlingame, who was formerly with the Hudson River Tunnel Company, has been reappointed, and has charge of surveys.

Mr. C. T. Church has been elected Chief Engineer of the Boston, Hoosac & Western Railroad, vice Mr. E. M. Leuffer, resigned. Headquarters at Mechanicville, N. Y.

Mr. J. M. Wolbrect, recently in charge of construction of jetties at Charleston, S. C., under Gen. Q. A. Gillmore, has been appointed Assistant Engineer on the Hudson River Tunnel, and has charge of construction on New York side.

The saddest part of the story of the lost Jeannette is that which tells how De Long and the men with him died. A frozen hand of the leader, sticking out of the snow as though raised up in appeal for aid, told the searchers where three of the bodies lay. In the pockets of all were pieces of burned skin cut from their furs, of which they had been eating. Starving, freezing, and almost exhausted, it seems that they had kindled small fires, and then actually crawled into the flame in the hope of warming themselves. Such experiences are almost too terrible to be told; but if the story will serve to deter men from encountering like perils under equally unfavorable conditions, it should not remain untold.

IN the way of vastness in a manufacturing establishment, nothing in the past or present can compare with the extent of Herr KRUPP's, at Essen. Of steam-boilers he has 439; of steam-engines, 456, their aggregate horse-power being 18,500; of steam-hammers, 89; of rolling-mills, 21; of furnaces, 1,556; of locomotives, 25; of machines for making tools, 1,622; and the population of this working-men's city is 15,700.

Dr. SCHLIEMANN tempers the heavy drudgery of scientific exploration by a generous diet and a liberal hospitality. He lives in an imposing marble palace at Athens, which bears on its front, above the door, the inscription in letters of gold: "Hall of Ilium." Here every other Thursday evening during the winter he entertains a hundred or more professors, journalists and statesmen. The spacious parlors afford room for more than three hundred guests. All the decorations of the house commemorate Dr. SCHLIEMANN's great researches. The floors are paved with Italian mosaics, the walls covered with Pompeiian frescoes and patterns of objects found at Troy and Mycenæ, and Homeric mottoes and inscriptions abound. At the family table classic Greek alone is spoken, and even the servants have classic names—the gardener is PRIAM, the porter BELLEROPHON, and the two nurses HECUBA and POLYXENA.

ENGINEER CORPS CHANGES. — The following changes have been made in the Corps of Engineers: Major FRANCIS N. FARQUHAR ordered to Detroit to relieve Major GODFREY WEITZEL of the duty connected with the river and harbor improvement. Capt. CHARLES E. L. B. DAVIS to relieve Major WEITZEL of his duty as as engineer of the 11th light-house district. Major WEITZEL being relieved, to proceed to Philadelphia and relieve Capt. WM. LUDLOW of the river and harbor improvement in his charge. Capt. LUDLOW to report to the Secretary of the Treasury for duty as engineer secretary of the Light-house Board. Capt. JAS. B. QUINN to report to Major CHAS. A. SUTER at St. Louis for duty. First Lieut. WM. H. BIXBY to report to Col. H. L. ABBOTT at Willets Point for duty.

Mr. EMILE LOW, who, with his father, Mr. SIGISMUND LOW, has recently returned from Mexico, gives an interesting account of life in the land of the Montezumas. These gentlemen were members of the party of engineers who went from the states to construct a branch road connecting with the Mexican Central railroad. Mr. LOW is of the opinion that Mexico and the Mexicans are misunderstood and misrepresented by the average traveler from the United States. Many correspondents who are sent there in the interests of American journals confine their investigations to the coast regions, and therefore receive wrong impressions of the climate and country. The party of which Mr. LOW was a member worked about 250 miles northwest of the city of Mexico, and he describes temperature in that district as delightful, the thermometer generally standing at 70 degrees. From 15,000 to 20,000 native laborers are employed in the construction of the Mexican Central, and in the matter of wages these men discount the Chinese, as they average 25 cents per day. They manifest a decided objection to that time-honored vehicle, the wheelbarrow, and prefer to transport the dirt in a piece of coarse cloth, which they lay on the ground to fill, then sling the loud over the shoulder and trot off to the dump. The morals of this class are none of the best, and many of the men and women pair off without the formality of marrriage. This state of things is due largely to the fact that a civil marriage is the only one recognized by the law, and the fees demanded by the authorities are so large that the lower classes are unable to pay them.

Mr. LOW is enthusiastic in the praise of the better class of Mexicans, whom he says are people of great culture and refinement and quite hospitable. The corps of American engineers in their expeditions were frequently entertained by the Mexican gentry; in fact, their company was eagerly sought after, and to offer a Mexican of the better class pay for hospitality was considered an insult. The commercial interests of the country are managed generally by Germans. The stock of the Mexican Central road is held in the main by capitalists of the United States, yet not a rail of American manufacture has been laid on the road. The construction supplies come from England and Belgium. As Mexico has no manufactories, all iron productions are imported from other countries, and the goods of all nations, except the United States, are sold there. Mr. LOW rather thinks that the Pittsburg glassblowers who recently returned from Mexico, have exaggerated their injuries, and that the fault was not altogether on the side of the Mexicans. He says that many Americans go there with the idea that they are in a country similar to our far West, and therefore proceed to become something of desperadoes, hence in a very short time they find themselves in the hands of the authorities. He says that he saw cases where the railroad attaches behaved in a manner which would have jailed them at home, and yet the Mexican people were particularly lenient and would release them on payment of a slight fine. The American consul now in Mexico is, according to Mr. LOW's statement, not very popular, and the American residents of Mexico generally desire his removal.—*Pittsburg Leader, June 23.*

RECENT INVENTIONS.

APPARATUS FOR VENTILATING AND PURIFYING SEWERS.

For the ventilation and purification of the sewers of a city, the inventor provides an apparatus consisting substantially of a disinfecting chamber, having double reticulated walls filled in with disinfecting material, combined and operating in connection with a suction fan or fans. The disinfecting chamber is connected both with the sewers and the open air, whereby the sewer gases may be passed through the walls of the disinfecting chamber by the action of the fan or fans, and thereby purified before being discharged into the open air.

RELEASING COCK FOR RAILWAY CAR-BRAKES.

To insure the quick release of railway air-brakes, a three-way cock is provided, one branch of which connects with the train-pipe, a second with the exhaust and a third with the main reservoir, the latter branch having a spring valve of resisting power equal to the reserve force which it is desired to retain in the main reservoir, and a supplementary passage leading around the valve from a point below it to the interior of the cock. By an additional turn of the handle the supplementary passage is opened into the train-pipe, and the reserve force of compressed air thrown suddenly upon the triple valves under the several cars, cutting off communication between the auxiliary reservoir and brake-cylinders.

CONSTRUCTION TENDER FOR RAILROADS.

The car is provided with a winged truss frame and a detachable derrick or boom. Suitable tracks are placed upon the car, on which trucks are adapted to run. Resting upon a platform supported on posts is a drum shaft capable of longitudinal movement, and which is a cylindrical and square portion, on which is secured a rigid and a loose socketed drum adapted to operate a traveling block backward and forward upon the boom or derrick.

HYDROCARBON FURNACE.

This improved furnace consists of the combination of a bat-wing injector and the water legs of the boiler, the steam pipes covered with refractory material and passing above the grate bars back and forth horizontally directly through a body of incandescent material, whereby the steam is superheated and passed directly in a superheated state to the liquid fuel injector, and discharged, in conjunction with the liquid hydrocarbon, in a broad thin sheet forwardly and laterally immediately out the incandescent fuel beneath the fire-bridge.

APPARATUS FOR OPERATING RAILWAY SIGNALS.

Great difficulty has heretofore been found in the use of wires for operating railroad signals, due to the contraction and expansion of the wires under different degrees of temperature. An English invention secures one end of a section of a signal operating rod or wire, a cylinder containing liquid, and the meeting end of the other section is secured to a piston or plunger working in said cylinder, whereby the expansion and contraction of the rods or wires is compensated for by the expansion and contraction of the liquid.

WASHINGTON, D. C. F. B. BROCK.

RAILROAD ECONOMICS.[*]

BY S. W. ROBINSON, C. E., OF THE OHIO STATE UNIVERSITY, MEMBER OF THE BOARD OF INSPECTORS UNDER THE HON. H. SABINE, COMMISSIONER OF RAILROADS AND TELEGRAPHS.

A law of the State of Ohio makes it the duty of the Commissioner of Railroads to inquire into the safety of the means employed in railway travel. To this end an inspection service has been organized, which aims to examine and report the condition of all the railroads of the State. While engaged in this duty the following items of information have been gained:

TRUNK AND OTHER LINES.

In Ohio, as well as in at least two other States, there appear to be two classes of railroads—first, the great trunk-lines connecting the West with the East, and, second, those having largely or altogether local interests. The former are most likely to run east and westward, while the latter run mostly north and southward. Strong companies control the former, while the latter often fail to pay well enough to keep up repairs. In many instances a weak company sells its interests to a stronger, when the former causes a general need of repairs. The strong company or trunk-line then puts the road into good running condition, sometimes to form part of a through line, sometimes a branch and sometimes to form a tributary to it. In this way a road of secondary importance may be kept up to good running condition, while otherwise it would go down.

Whatever may be said against consolidation of railroads, it appears to be a fact that roads owned by strong and wealthy companies are in far better condition than otherwise. Indeed the generally good condition of the great trunk-lines and of their branches is a credit to those companies. If these roads are backward in some things, such as introducing the best systems of "signaling," "blocking," and of "interlocking apparatus," they are certainly up in other matters, such as steel rails, iron bridges, etc.

SAFETY.

A little attention to railroading will suffice to show that safety in railroad travel is the price of incessant vigilance. That a stretch of three hundred miles, extending across a State is, every foot of it, perfectly safe to-day, is not proof positive that it will be so to-morrow, though the broken rail or washed culvert is the subject of constant search.

PROTECTION OF RAILROAD STRUCTURES.

The life of railroad plant is not great. New roads, with iron rails and wooden structures, will need renewals for the most part within ten years. Rails endure according to traffic and for light traffic will run ten years. Ties will rot out in from five to eight years. Culverts, cattleguards, etc., about the same. Good wooden bridges, when new, will be dangerous in ten years unless covered. If covered at all it should be done within two years after building; otherwise the timber becomes affected with dry rot at the heart. This decay might perhaps better be called *blind rot*, because it is hidden. A wooden bridge, nicely covered and painted, may *appear* to be in the best of condition, but really be in the very worst. Joints in the lower chord of such bridges are seen to be pulling out by the locks splitting off. In such cases when the timbers are sounded with a boring bit the latter will find sound wood for 2 or 3 in., when suddenly the bit may take a jump of 4 or 6 in. through a dry rot hole. Such well-covered and well-appearing bridges are found not to have been covered under about three years after building. Equally good uncovered bridges, even better, ten years old, have been found than those of equal age, well covered, in which the covering was delayed three years. It appears that after three years of exposure to open weather a bridge is doomed to a life of only about ten years, covered or uncovered.

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[*] Extract from a paper read at the annual meeting of 1881 of the American Society of Mechanical Engineers.

But by prompt covering of wooden bridges the life is more than doubled, from which it appears that the practice of covering such bridges is highly economical.

It is sometimes the practice to cover simply the trusses, and it is necessary in "half Howe" or "pony" trusses of wood. This leaves the floor system exposed, and any sap wood about the floor-beams or the stringers is soon eaten away with decay. Sap is of but little worth after three years exposure, even when free. But heart wood is often perfectly sound at ten or fifteen years. Sap wood is so comparatively worthless that some engineers specify that not over 8 per cent. of section of timbers shall be sap. It is an excellent precaution to thus limit the sap wood, because it is practically of no value. In existing bridges sap wood rot has reduced the section of chords, as estimated, from 10 to 20 per cent., the remainder being sound. Uncovered flooring, should, therefore, be watched, and when the beams are found weak, as by observed excessive deflection, new beams should be added.

Painting is an excellent practice, and its power for prolonging the life of wood is not confined to free or external surfaces, but internal as well,—that is, to illustrate, lower chords have been examined where the wooden "clamps and keys" were laid in white lead, or sometimes in red lead, and such are sound and strong to a greater age than unpainted.

A close joint in wood, where exposed, is far worse than open joint of small space sufficient for air to pass From this fact it appears that wood contracts have been avoided by using iron "clamps and keys" in lower chords. Some engineers make iron clamps or blocks with a space for ventilating between wood and iron, the bearings being quite narrow. These have given good results, and point to the value of ventilation.

As to ventilation in general, all coverings should leave the main bridge timbers free for air to circulate about them. For instance, the boarding along the sides of trusses should be firred out by girt strips being nailed to the truss along the braces above the lower chord and below the upper chord, and not on the chords themselves. Then, when the boarding is nailed upon these girts, it stands out free, so that air can freely go all about the chords.

In some instances chords have been found covered with tin, the same being fitted about the braces and nailed to the chords, so as to appear like giving protection to the chords beneath. But this is believed to be worse than no covering whatever, from the simple facts that, first, water will work in at the numerous joints; and, second, be held there by the tin covering. If the tin could be carried away from the wood by a 2" space, the latter being allowed for ventilation, it will serve a good purpose when it is made tight. These conditions are really met in "combination" bridges; that is, in such as have wood upper chord braces and end posts, but with iron ties and lower chords. The upper chords are readily covered with tin, because nothing protrudes above to prevent. The braces, or vertical pieces generally, do not need covering, as it is found that the wet so rapidly escapes as to leave the braces soon dry.

Special pains should be taken to keep wet out of close places in wood. For instance, in deck bridges (Howes), water is apt to leak through the roof, as it is difficult to lay a roof among the ties, floor-beams, string, etc., in the floor system and get it tight. In such cases the sway braces are apt to carry the water which falls upon them down upon the lower chord. This has been avoided very neatly, cheaply, and efficiently on the Lake Shore & Michigan Southern Railway, by making a saw cut across the top and edges of the sway braces, and driving in a collar of sheet iron or tin, which extends down like spurs below, and thus heading off any water which may find its way through the floor or roof above, and alight upon the sway brace to come trickling down upon the lower chord.

But though tin may be suitable to cover upper chords as above explained with reasonable durability, yet as a main roof covering over the tops of Howe bridges it appears to be utterly worthless, for the reason that the sulphurous fumes of the smoke from the locomotive soon eats the tin roof through like a big pepper-box lid. Indeed this action has been observed upon heavier masses of iron than tin; the truss rods even having been observed in badly rusted or pitted condition, with a weakening of probably 5 to 10 per cent. The latter has been observed to be most serious in low lands, such as would be frequented by fogs. The moisture of the latter deposits upon the rods and absorbs the acids of the smoke. The iron is then etched more or less seriously. Rods for such localities should be made with some excess of section to provide for the corrosion.

WOODEN BRIDGES.

The prevailing wooden bridge is the Howe truss. It consists, as generally put up, of an upper and lower chord, connected by vertical tie-rods running through with nuts at both ends; the latter dividing the span into panels containing braces and counter-braces. The chords usually are made of four sticks, side by side, with blocks or "keys" notched in, but leaving a space between all the sticks. Chord bolts run through from side to side of chord to draw all together. In short chords the sticks run from end to end. But for lengths greater than about 40 ft., pieces are put in so as to break joints. In upper chords these simply abut against each other, but in lower chords clamps are used to made tension splices. These clamps are generally of oak wood; sometimes only one is used to a splice, but more often two, one on each side of pieces joined. A chord bolt goes through near each end of a clamp. The earliest point of failure in a wooden bridge is at the locks of these clamps, either on the clamp itself or on the interlocking hooks of the chord.

Two of these splices are never found opposite in a chord, but break joints, so as to allow one joint to each panel. In this way the so-called keys help to form the slice. There are always two main braces and one counter brace between in each panel. The former always incline toward the middle span point. In moderate spans there are always two tie rods at each inter-panel point, but in long spans there may be three at the ends of truss. The largest of these rods are 2 inches in diameter; almost always threaded without enlargement of ends. These ties draw against straps on the ouside of the chords, running from 1" x 5" down to ½" x 3" in section, and long enough to extend the width of the chord. The braces almost always set square against iron angle blocks. The best of these blocks have flanges to prevent the braces from falling out of place. These blocks are often found broken, but the breakage is evidently due to carelessness in drawing up the tie rods too tight upon the braces, because on some roads these breaks are very numerous, while on others the same make of blocks are never found broken. Road-masters say they find difficulty in getting men to draw their ties up properly upon the braces.

The depths of these trusses vary. Short spans, or "pony" trusses, sometimes also called half trusses, run from about 8 to 12 feet height. Full trusses for longer spans are usually about 20 feet. The smaller trusses have about three or four floor beams per panel, while the larger have five. They always rest upon the chords.

When wooden bridges show signs of failure the speed of trains is often reduced till a remedy is applied, either in strengthening the bridge or by renewing it. Two ways of strengthening a lame bribge are in use. One consists of springing a wooden arch from the abutments, usually from iron skew backs, placed about 6 feet down, and rising at mid-span nearly to the tops of the trusses. Each case requires four arched ribs, one on each side of each truss. From the arches the trusses are suspended by rods. But this method is too expensive for an old bridge; it is more common for a light bridge otherwise good. The second way to doctor the bridge, and which is very common for old bridges, is to put a trestle bent under at the third or quarter span. A pile bent is sometimes used instead of a trestle bent. The objection to placing the bent at the middle is the fact that the counter-braces near the middle in that case become main-braces. Some less considerate road-masters place the doctor at the middle, however. But as the carrying power of a truss varies inversely as the square of the span, other things being equal, it appears that the strength of a bridge is nearly doubled by placing a support at the one-quarter point. Such trestle bents are carefully watched to guard against washing out by the stream. In high water such a trestle bent is a treacherous affair, a pile bent being far preferable.

The lateral bracing in bridges is almost always about the same, viz., about 6 + 6 braces and 1½ tie rods, and the same from end to end of bridge. These are usually in the plane of the lower chords and also upper. No difference is made in the strength of the lateral bracing, as far as observed, for straight or curved track, though it is certain that the centrifugal force of a train running on the curved track over a bridge will give cause for lateral thrusts, which are considerably greater than for straight track. One element of compensation, however, exists in the fact that bridges under curved track are usually wider, so as to allow equal clearance room, and this gives wider lateral trussing. Trusses are not found inclined on account of curves on the bridge.

Through bridges of wood have no "sway" bracing. The chords of the trusses are from 24 to 30 inches in breadth, and the floor-beams extend entirely over to the outsides. This keeps the lower chord in position. The braces cover about the whole width of the chords, so that the trusses are quite stable in erect position.

Deck bridges always have sway bracing, but in some cases much stronger than others. Where several spans of wood bridges are contiguous, in some cases both or all are made continuous from span to span. In other cases only one chord will be continuous. Diagrams taken, as hereafter explained, have shown that in continuous two span bridges an appreciable rise of the second span occurs when the train gets fairly on the first.

THE CONSTRUCTION AND MAINTENANCE OF PUBLIC ROADS.

This is the title of one of the miscellaneous reports presented to both Houses of Parliament which go far to redeem the English Blue Books from being so much waste paper. The publication contains a number of reports from Her Majesty's representatives in the various European States, and will be valuable as showing the practice pursued in these various states for the construction and maintenance of the public roads. As we intend to abstract this report pretty freely, we shall not do more at present than call attention to it, and refer to its contents generally. The reports are, perhaps, more statistical than scientific, and more directly applicable to the question of how certain necessary moneys are obtained, thanks to the question of the size of the granite or other stones used. Such information as this would by itself be very valuable, inasmuch as it enables comparisons to be made; and if the cost of well-constructed and well-maintained roads in other countries can be shown to be less than the corresponding costs here, the matter should be fully considered. The question of cost depends on method or material. If good material is at hand, then, of course, the cost is comparatively small; but these reports, to have given the greatest interest, should have given more details as to materials used, how and whence obtained.

It will, perhaps, be best to take the countries somewhat in the order given. Thus:

Austria has roads both under and not under State control. The former are under the supervision of the Government, and the money required for them is stated in the Council Budget. The material used for mending the roads in Lower Austria is of a very inferior quality, so much so that some years ago a reward was offered for the discovery of some suitable and more solid substance, but without practical result. In Bohemia really good material (basalt) is obtainable, also in Moravia, Silesia, and the Tyrol, where granite, gneiss, and hard limestone are available. The total length of State roads is 15,275 kilometers, and a decree of 1848 ordered that these roads should have a maximum width of 9·48 metres (30 feet). More recently this has been increased to 12 metres.

The Austrian Government have of late paid much attention to the condition of the roads, and many systems have been tried for the improvement of their maintenance and repair. At one time most of the work was done by contract, various portions being let off on leases of nine years, the contractor receiving a certain sum for the material required, and also for the repair of the bridges; but the actual wages of the road-cleaners were paid by the Government. The fault of this system was that the road-cleaners, who were paid by the State, were dependent on the contractor for their places, and it was not possible to form any just estimate of the amount of work on the roads so many years in advance. This and many other contract schemes all proved unsuccessful, and the state roads are now entirely under the administration of the government and its duly appointed officials.

There are now 3,479 road-cleaners regularly employed on these roads, as, with a view to economy, their number has of late years been very much reduced, thus making the total length for which each one is held responsible amount to 4½ kilom. These men earn from 15 to 24 florins a month, and in the spring and autumn, when there is much heavy work on the roads, they are allowed a certain number of extra laborers. The inspectors have been reduced from 586 to 414, each having 36.32 kilom. in charge.

The technical method of repair now in use is generally acknowledged to be the most practicable and economical, and consists in the laying down of a large quantity of material on the roads in the spring and autumn, and in the continual repairing of all defects, and in the clearing off of all dust and mud by the road-scrapers. Another system that was at one time tried was the so-called "patch system" (*point-à-temps*), by which the roads had to be cleared of all dust and mud, the ruts, wheel-tracks, and other defects filled up with gravel, and the soil round the damaged part had also to be loosened and afterwards beaten together until a consolidation of the two parts was obtained, thus forming a smooth and even surface, with the proper amount of slope required to drain off all wet.

The difference in these two systems is that the former requires a greater amount of material and the latter more labor, but it was found on trial to be far too costly, and that the use of the rollers necessary was in many cases attended with great difficulties, and also on account of the small number of roads constructed on the macademized principles, so the Government have now again returned to the former system.

The other roads are either provincial, district, or municipal, according as they are maintained by the province, a district committee, or a municipality. It will suffice if we refer to the districts.

In those provinces where district representative bodies exist, as in Styria, the Tyrol, Bohemia and Galicia, the district roads are under the direct control and management of the district committees; but in the other provinces committees, composed of from five to fifteen members, are elected for three years by the various districts according to their size and extent. The highest taxpayer, and also a member of the Permanent Committee of the Provincial Diet, are always appointed to serve on each committee, but no remuneration is made to any of the members for their services beyond a right to charge expenses.

The cost of maintenance and construction of these roads is provided for by rates levied in proportion to the amount of direct taxes paid by the inhabitants. These committees have the power to raise the tax up to 15 per cent. of the total amount of the above taxation, but should any further increase be necessary the consent of the Diet must be obtained. In the poorer districts, where, on account of the small amount of taxes paid, it is found impossible to raise a sufficient sum for the proper maintenance of the roads, assistance is given by the provincial government from a fund provided for that purpose; and for any special outlay, such as the construction of bridges, etc., advances or loans are often granted without any payment of interest. The cleaning and repairing of both the provincial and district roads is carried on by regularly appointed road cleaners, to whom certain portions of road, from two to four kiloms. in length, are allotted, and for whose maintenance and condition they are held responsible, a certain number of day laborers being allowed them, according as they may be required. The regularly appointed provincial or district road-cleaner earns from 20 florins to 30 florins a month, and has a claim to a pension when unable any longer to perform his duties. Technical engineers are also appointed for each district by the provincial government to inspect and superintend all works of importance, such as the renewal or construction of roads and bridges.

The provincial and district roads ought, according to law, to be constructed on the macadamized principle, and with a breadth of 6 metres, not including the space necessary for ditches or for the planting of trees. The macadamizing of the center part of these roads consists in laying a foundation of broken stones of a depth from 15 to 20 centim., with a covering of 15 centim. of gravel, and with an incline of 1 in 18; but owing to the great expense involved in this process, it is only adopted in the construction of new roads, or those where the traffic is very heavy, the older roads being almost all constructed without the first layer. The planting of all provincial and district roads with trees at a distance of 20 metres apart is also legally authorized. The construction and reconstruction of bridges, canals and dykes is carried out in as solid a manner as possible, the older ones being now replaced by those of stone, brick, and iron, and where the safety of the traffic requires it, large curb and corner stones are placed.

A special class of district roads must also here be mentioned, viz.: those leading to railway stations or large industrial establishments, the cost of maintenance and construction being in general divided between the persons interested. Turnpike charges have, since the year 1870, been abolished on the provincial, but still exist on many of the district and municipal roads, and tolls are often levied for the maintenance and repair of bridges.—*The Contract Journal of London.*

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MERIDIAN LINE.*

The following process has been used by the undersigned for many years. The true meridian can thus be found within one minute of arc:

Directions.—Nail a slat to the north side of an upper window—the higher the better. Let it be 25 feet from the ground, or more. Let it project about three feet. Near the end suspend a plumb-bob, and have it swing in a bucket of water. A lamp set in the window will render the upper part of the string visible. Place a small table or stand about 20 feet south of the plumb-bob, and on its south edge stick the small blade of a pocket knife; place the eye close to the blade, and move the stand so as to bring the blade, string, and polar star into line. Place the table so that the star shall be seen very near the slat in the window. Let this be done half an hour before the greatest elongation of the star. Within four or five minutes after the first alignment the star will have moved to the east or west of the string. Slip the table or the knife a little to one side, and align carefully as before. After a few alignments the star will move along the string—down, if the elongation is west; up, if east. On the first of June the eastern elongation occurs about half-past two in the morning, and as daylight comes on shortly after the observation is completed, I prefer that time of year. The time of meridian passage or of the elongation can be found in almost any work on surveying. Of course the observer should choose a calm night.

In the morning the transit can be ranged with the knife blade and string, and the proper angle turned off to the left, if the elongation is east; to the right, if west.

Instead of turning off the angle, as above described, I measure 200 or 300 ft. northward, in the direction of the string, and compute the offset in feet and inches, set a stake in the ground, and drive a tack in the usual way.

Suppose the distance is 250 ft. and the angle 1° 40′, then the offset will be 7.271 ft., or 7 ft. 3¼ in. A minute of arc at the distance of 250 ft., is ⅞ of an inch; and this is the most accurate way, for the vernier will not mark so small a space accurately.

ANGLE OF ELONGATION.

This should be computed by the surveyor for each observation. The distance between the star and the pole is continually diminishing, and on January 1, 1882, was 1° 18′ 48″. There is a slight annual variation in the distance. July 1, 1882, it will be 1° 19′ 20″. If from this latter quantity the observer will substract 16″ for 1883, and the same quantity for each succeeding year for the next four or five years, no error so great as one-quarter of a minute will be made in the position of the meridian as determined in the summer months. If winter observations are made, the distance in January should be used. The formula for computing the angle of elongation is easily made by any one understanding spherical trigonometry, and is this:

$$\frac{R \times \textit{sin. Polar dist.}}{\textit{cos. lat.}} = \text{sin. of angle of elongation.}$$

As an example, suppose the time is July, 1882, and the latitude 40°. Then the computation being made, the angle will be found to be 1° 43′ 34″. A difference of six minutes in the latitude will make less than 10″ difference in the angle, as one can see by trial. Any good state or county map will give the latitude to within one or two miles—or minutes.

The facts being as here stated, the absurdity of the Ohio law, concerning the establishment of county meridians, becomes apparent. The longitude has nothing at all to do with the meridian; and a difference of *six miles* in latitude makes no appreciable error in the meridian established as here suggested, whereas, the statute requires the latitude within *one-half a second*, which is *fifty feet*. There are some other things, besides the ways of Providence, which may be said to be "past finding out." It is not probable that a surveyor would err so much as *three* miles in his latitude; but should he do so, then the error in his meridian line, resulting from the mistake, will be *five seconds*, and a line *one mile* long, run on a course 5″ out of the way, will vary but *an inch and a half* from the true position. Surveyors well know that no such accuracy is attainable.

R. W. McFarland.

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*From Proceedings of the Association of County Surveyors of Ohio at its third annual meeting held in Columbus in January last.

LITERATURE.

Local Government in New York, by E. W. Bemis.—The management of local affairs in New Netherlands was in the hands of village magistrates nominated by the people and confirmed by the Governor. With the influx of immigrants from New England, after the conquest of New Netherlands by the English in 1664, came important modifications of the Dutch system of local government. In 1684, New York was divided into counties. This English unit of administration still obtains an important place in the local autonomy of the above State. The county is composed of towns from thirty to sixty square miles in area. Powers of county legislation are invested in county boards, consisting of the supervisors or heads of the several towns forming the larger unit. The county boards issue warrants for the collection of all taxes in support of roads, bridges, erection of court-houses and other county purposes. Town assessors report to the county authorities. All purely local officers are elected by the towns in town meeting assembled. The towns can make by-laws and establish penalties for local offences; they can regulate their own common schools, common lands, fences and town property; they can raise money by local taxation for public uses, such as roads and bridges, if more than the county allowance is needed. The distinguishing feature of the New York system of local government, as compared with the New England system, is the great power of the county in the control of its towns. New York has a compromise system, combining the best features of the New England town and of the Southern county. From the New York system has developed that of Illinois, Michigan and Wisconsin.

Local Self-Government in Pennsylvania, by E. R. L. Gould.—In early colonial times, under the administration of the Duke of York, the town or parish was the center of local life. County government did not practically exist. All town officers were under the management of a constable and a board of overseers, who promulgated constitutions and by-laws and adjudicated petty cases in the "Towne Court." This body also looked after the ecclesiastical interests of the parish. The local administration of this period was essentially a reproduction of the English system. In the early stages of proprietary rule the town lost its former position and the county became most prominent. The County Court of Quarter Sessions was the center of authority, and rates were levied, roads opened, bridges constructed, and the poor cared for under county direction. Subsequently the charge of paupers and highways was transferred to the township, on which the overseers and supervisors laid rates to cover expenditure entailed by these burdens.

The Pennsylvania system at the present time is a compromise between the town polity of New England and the county administration of the Southern States. The system aims at a partition of powers. There is no town meeting where the people may come together and frame by-laws for their own government. Neither is the township represented by a supervisor upon the County Board as in New York, Michigan, Illinois, and other of the Northern and Northwestern States. The township officers have the power to levy a road tax, but only on the basis of the last adjusted county valuation. County assessments are made to defray the ordinary expenses of local government. The poor are usually, though not always, a county charge, and when such is the case are supported from the general county fund. The county is the leading local unit and, under the commonwealth, may be said to wield the largest share of political power. It regulates affairs directly and its officers are responsible to the people for the exercise of administrative control. [This paper was read before the Pennsylvania Historical Society, May 1, 1882, and is now in press.]

Local Self-Government in Illinois, by Albert Shaw.—The local institutions of the West are not novelties nor experiments. In main features they reproduce those social arrangements under which the Anglo-Saxon insists upon living, wherever he may be transplanted. Illinois may be taken as the model western State in respect to local government. The precise form which its institutions have assumed has been largely shaped by the State's history. Illinois illustrates the tendency of migration to follow the parallels of latitude. Its southern half was peopled from Southern States, especially Virginia, while men from New England and New York occupied the northern half. The settlers brought their ideas and habits with them. The New England men came from self-governing agricultural communities, where the people made laws, chose officers and voted local taxes in the democratic "town meeting." The New England county was little more than a name; the township was the real political unit. The Virginia settlers, on the other hand, had not been accustomed to organized neighborhood life or to local self-government. In the States of the South, county officers appointed by the State government administered State laws.

Illinois passed from French to English hands in 1763 and was in 1778 made a Virginia county. A decade later it passed under the government established by the ordinance of 1787, which confirmed forever to the people many great principles. In 1818 it was admitted as a State. Its early connection with Virginia, as well as the temporary government erected under the ordinance, had already given a Southern cast to its administrative forms. The southern half of the State alone being settled at the time of its admission to the Union, the Constitution of 1818 naturally provided for a county system similar to Virginia's. Southern migration to Illinois declined after the Missouri Compromise of 1820 and Northern people filled up the State. The new Constitution of 1848 compromised with the two systems of local government by providing that counties might, on popular vote, be placed under township organization. The northern counties at once adopted the township system, southern counties remaining under the county system. At the present time about four-fifths of the 102 counties in the State are under township government. This result was materially furthered by the United States Land Survey System, which divided the public domain into townships and allotted land in each township for school purposes.

The annual "town meeting" of the whole voting population is the central fact in township government. At this meeting the people elect local officers, discuss neighborhood interests, vote taxes and enact by-laws and rules covering a wide range of local topics. The supervisor is the business officer of the township, and the supervisors of the several townships constitute a County Board which manages county affairs. Highways and schools are provided for by the townships, while the care of the poor is entrusted either to the county or the townships as the people may determine. Each township elects two justices of the peace. The county maintains a judicial establishment and controls matters which concern the townships in common. As in the South, so in Illinois and throughout the West the county is the political unit within the State. General laws provide for the incorporation and municipal government of "villages" and "cities," requiring a minimum population of 300 for the former, and of 1,000 for the latter. The compass of this abstract precludes details of county, township and municipal governments as provided for in the statutes of Illinois.—*Johns Hopkins University Circular.*

NOTES.

COMPOUND LOCOMOTIVES.

The gradual encroachment which steam is making upon the ocean carrying trade is due in great part to the cheapness with which the adoption of compounded engines enables steamships to carry freight. There is some prospect that the same principle may be applied to land carriage, as an Englishman, Mr E. W. Webb, Superintendent of the London and Northampton Railroad, has invented what he names a "compound locomotive." Its purpose is to economize fuel by the use of both high and low steam. There are two sets of driving wheels, which are not connected, but each set is driven by independent engines. The steam is first received under high pressure in two cylinders placed on each side of the boiler, and about half way back. The pistons of these work the rear drivers by direct motion. The steam from them is then exhausted into pipes which are conducted in front of the boiler flues to keep the steam hot, and then into one large cylinder located directly under the front of the boiler. This cylinder carries, by a shaft under the boiler, the forward drivers. The new locomotive has run 5900 miles in the "Irish Mail" service, and the consumption of coal has only averaged 22$\frac{1}{10}$ pounds per train mile, including that required to get up steam—a saving of over 25 per cent. upon the ordinary requirements.

TERRIFIC FORCE OF CLOUD WATER.

During the past week there have been half a dozen cloud-bursts in various sections in the eastern part of Nevada. The boss "burst" would seem to be that which occurred last Sunday in the mountains east of Oreana, and which swept away a stone railroad culvert 30 ft. wide and 20 ft. deep. An eye-witness asserts that the current of air created by the large body of water would have drawn a person into it from a distance of 20 ft. Steel rails weighing 60 pounds to the yard stood on end like telegraph poles, and the solid stone masonry work of the culvert was swept away like so much rubbish. It is impossible to estimate the wonderful velocity this body of water had reached when it came upon what was almost a solid stone barrier. It was like the stroke of a battering ram.—*From the Virginia City Enterprise.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

WATER-WORKS TO BE BUILT.—Messrs. Goodhue & Birnie, of Springfield, Mass., will commence next week on the construction of water-works at Spencer, Mass., a manufacturing town of 9,000 inhabitants; cost of works about $150,000; gravity system; source of supply, Shaw's Pond, 175 ft. above the main street in Spencer. Town will pay $50 per annum per hydrant to the company, who build and own the works, Messrs. Goodhue & Birnie being the principal stockholders. There will be 14 miles of pipe from 4 in. to 16 in., wrought iron, cement-lined, manufactured by the contractors. Hydrants will probably be of Pattee & Perkins, Holyoke, make, and valves from Chapman Valve Co. The contractors intend to get the water let on this year. Messrs. Goodhue & Birnie are putting in a new 18 in. pipe in addition to the old 14 in. pipe found insufficient for the town of Concord, N. H.; contract price, $44,600. They have also just completed water-works at Lee, Mass., and are making extensions at Waltham and Nantasket Beach, Mass. Messrs. Goodhue & Birnie report plenty of business throughout New England.

CLEANING THE TORONTO RESERVOIR.—The reservoir at Rose Hill is now being cleansed, the water having been left off a few days ago. It is not in a very filthy condition, the principal accumulation since last cleaning being a small quantity of *debris*, deposited mud, and a few vegetable growths. The city is now supplied with water being pumped into the large mains direct to supply the demands. The cleaning operations will be completed to-day.

ATLANTIC, IA., is to have water works that will cost $62,000.

THE CITY OF ORANGE, N. J.—The city of Orange is to be supplied with water by damming a natural basin at Milburn and conveying the water in pipes by its own gravity to a reservoir near the city. A daily supply of 1,700,000 gallons can thus be obtained at a cost of $400,000, which includes land and all expenses of construction, &c. It is calculated that the system will give a head of 88 feet above the highest point in the city.

BRUSH VALLEY (PA.) WATER WORKS.—We have received the following note from this place: The Locust Mountain Water Company is constructing water works here to supply the towns of Mount Carmel, Centralia and the surrounding collieries. The works in course of erection consist of an embankment 900 ft. long across the valley, forming a lake about 25 acres in extent. The overflow will be a crib dam, 50 ft. in length, built over the present site of Roaring Creek. The water will be pumped through a 20 in. pipe to the top of Big Mountain, to a point 650 ft. above the present level of the creek, by means of two Worthington compound duplex pumping engines, one at the lake and the other half way up the mountain. From the top of Big Mountain an 18-in. line runs for about one mile and a quarter to a distributing reservoir capable of containing about 30,000,000 gallons. Thence pipe lines of various diameters will convey it to the collieries and towns. It is proposed to complete the lake supply line and distributing reservoir by December next, leaving the distributing lines to be built next year. The contract has been awarded to Mr. C. S. Nesbit, of Montana City, Pa. The Chief Engineer is Mr. T. S. McNair, of Hazleton, Pa., and the work is in charge of Mr. Wm. Seesmiler, late of the Baltimore water works.

ARTESIAN WELLS.—The artesian well bore is now down 1740 feet, and the drill is still working in very hard rock. The character of the formation has changed within the last day or two, and the present rock is believed to be Trenton limestone. Certainly the lime is very prominent in it. The approximate thickness of this limestone is placed in White's geology at 200 feet. Below this, in the natural order, should be St. Peter's sandstone, and when that formation is reached the company hopes to meet its ample reward.—*Sioux City (Iowa) Journal.*

INCREASE OF CAPITAL.—The gas company at East Hampton, Mass., has voted to increase its capital stock from $25,000 to $30,000, and to build another gas holder.

NEW WATER-WORKS.—In a letter from Clinton Rice, of the *Railway Age*, headed Rincon, N. M., we find the following item in regard to Lake Valley, N. M.: "The Lake Valley Water-Works, also working under and controlled by the same parties, commenced operations simultaneously with the mill and reduction works. By its operation fresh, pure water from a lake on the old McEver's ranch is conveyed a distance of four miles to Lake Valley and the mills, with a capacity of 600,000 gallons per day."

THE NEW FISHKILL (N. Y.) WATER WORKS CO.—The name of the company is the Highland Water-Works Company; capital stock $100,000; incorporators, Lewis Tompkins, Willard H. Mase, H. A. Alden, C. M. Wolcott, C. L. Kimball, S. G. Smith and James Mackin. The company propose to obtain a supply from the following sources: From the Fishkill Creek above all sources of pollution; from the "Trout Brook," so called, flowing into the Fishkill Creek on the east, a short distance above Matteawan; from the stream or brook flowing into the Fishkill Creek on the east, near the village of Fishkill; from the reservoir formed by the erection of a dam or dams on or near Gut Pond, so called, in the town of Pleasant Valley; from the reservoir formed by the erection of a dam or dams, and the consequent storing of waters in Little Pond, so called, in the town of Pawling; from the various streams, brooks or creeks tributary to the Fishkill creek.

WORK on the Hagerstown, Md., water-works has been temporarily suspended until after harvest.

THE TRIAL of the Milford, Mass., water-works hydrants will take place to-day at 1 P. M. This trial is preparatory to the acceptance by the town of the hydrant service.

EXTENSION OF WATER-WORKS.—The citizens of Constantine, Mich., have voted $11,000 to extend their water works.

PLANS FOR EASTHAMPTON, MASS., WATER-WORKS.—Engineer E. C. Davis has completed the plans for the proposed water-works from Turkey Brook. By them it will be necessary to lay some 4¾ miles of main pipe, 12-in. cast-iron pipe being recommended, though different thicknesses will be required as the pressure varies, and the pipes will be very heavy in the meadows near the village. The cost, including reservoir, gate-house and main pipes, will be about $80,000. Other expenses will be land damages, which cannot be much, as the pipe will run in the highway for a long distance, right of way and damage to mill owners. Under the latter will come all the mill owners below Loudville on the Manhan River, but it would not effect the water privileges of the mills in the village as the water would go back into the stream again. Mr. Davis advises building several small reservoirs on the stream, and thus keeping the water moving, rather than one large reservoir. He advises taking more thorough measurements while the water is low in the stream this summer, but thinks the supply will be ample.

WILL BUILD WATER-WORKS.—The city council of Grand Forks, Dakota, has approved of having city water-works. The mains will cover the greater portion of the city, and the people will vote for or against the raising of $15,000 for the purpose.

PALATKA, Fla., will be supplied with water from artesian wells.

THE WEST CHESTER, PA., water-works are to be enlarged.

ELECTRICITY.

KEOKUK AND NAUVOO, Iowa, are connected by telephone.

ELECTRIC LIGHT AT TIPTON, IOWA.—Towers 150 ft. high are being erected, from which will be displayed electric lights for the illumination of the town.

ELECTRIC LIGHT AT FOND DU LAC, WIS.—Under contracts authorized by the Common Council it is proposed to light the city about Sept. 1 with electric lights from six towers. The towers are to be erected upon public buildings at a cost of about $3,400, and are to be the property of the city, while the lighting of the lamps, furnishing "the plant," and the power for running the same are to be done by contract for five years at $5,500 per year. The Brush system is the one adopted, and the whole scheme is subject to rejection by the Common Council on 60 days' trial.

ELECTRICITY is applicable to a variety of uses in connection with railways. On the Eastern Railway of France recently, experiments were made with a train having an electric brake, electric communication between the carriages, and electric lamps in each compartment of the thirteen vehicles. If the train had been drawn by an electric motor, as it may be some day, the adoption of the electric fluid to the purposes of locomotion would apparently have been complete.—*Exchange.*

TESTING AN ELECTRIC SIGNAL.—The New York, Lake Erie and Western Company is testing a newly-patented electric signal at the eastern junction of the Bergen County Short-cut with the main line. A magnet is set alongside the track of the Short-cut fifteen hundred feet from the junction, which, every time a car wheel passes over it, rings a telephone bell at the junction. This warns the watchman posted there that there is a train coming on the Short-cut, which is to go on the main line, and he sets the signals and switches accordingly. There is another arrangement which causes an automatic red danger signal to appear on the Short-cut whenever there is a train on the main line approaching the junction from either direction. The signal has been found very useful there, as there is a short curve and a hill which cuts off the view between the main line and the Short-cut beyond, a distance of a few rods on the latter. Thus far it has worked like a charm.—*Middletown (N. Y.) Press.*

THE CABLE from Galveston to Vera Cruz has been completed. This puts Galveston in direct communication with the whole of South America.

TELEPHONES number 192 in Jackson, Mich.

RIVERS AND HARBORS.

TORONTO HARBOR.—The Dominion Government Engineer, Mr. Perley, has had plans and specifications prepared for the projected improvement of Toronto Harbor, by the construction of extensive works at the Island. When these improvements are completed the navigable entrance through the eastern gap will be 500 feet in width, and deep enough to allow the entrance to the harbor of the largest lake steamers. The western channel will also be protected from the encroachments of the sand, which has been rapidly forming a dangerous bar between the Queen's wharf and Hanlan's Point. The works at the eastern part of the Island will make the dwellers thereon feel secure in their houses, and no danger to the central part need be again apprehended. The projected works will be pushed forward without delay.

STREETS, DRAINAGE, ETC.

MILWAUKEE PAVEMENTS.—The Board of Public Works desired to pave certain streets with Waterloo stone, but the Aldermen decided to lay cedar blocks. In about one year after the work has been finished the Aldermen will, in all probability, be convinced of their error.

CEDAR BLOCKS.—The Common Council of Minneapolis recently passed a resolution to pave a certain business street with cedar blocks, "laid upon a suitable foundation." This was vetoed by the Mayor, who advocated granite. The resolution was passed over the veto, and now another city will become wise by experience, and will pay dearly for its tutoring.

TUNNELS.

MULLAN TUNNEL ITEMS.—The difficulty of draining the deep cut on the other side of the mountain has been overcome. The work of getting the air compressor into order is being rapidly pushed forward, and will be ready as soon as the shaft is completed, which will be in the early part of next month. When the shaft is sunk to the depth of 140 ft., tunnelling will commence in both directions, and also at the same time from the west end of the tunnel toward the east. The Northern Pacific Railroad survey party is cross-sectioning and a half mile below the Eleven-Mile House, and has yet a considerable amount of rough work ahead of it, especially through the canon.—*Helena Herald.*

CANALS.

POSTPONEMENT OF CANAL CONTRACTS.—The Department of Railways and Canals, Ottawa, Canada, has postponed the letting of the works for the Fenelon Falls, Buckhorn and Burleigh canals, advertised to take place on July 5, until Wednesday, Aug. 2 next. Plans, specifications, etc., will be ready for examination (at the places previously mentioned) on Saturday, July 15 next.

PUBLIC WORKS TENDERS.—The real object of the government in making a show of proceeding with so many public works just on the eve of the general elections is now being shown. In few, if any, of the cases in which tenders were called for is the work ready to be proceeded with. The time of reception of tenders for the construction of the Cornwall post-office has already been extended, and now the reception of tenders for the Trent Valley works has been postponed from July 5 to Aug. 2. A similar postponement in other works advertised may be looked for.—*Toronto Globe.*

RAILROADS.

The National Railway.—The Chairman of the House Committee on Pacific Railroads has reported to the House of Representatives a substitute for the original bill proposing the incorporation of the National Railway. This substitute authorizes the company to build a railroad from Washington to the Hudson River opposite New York, and grants to it the power to appropriate lands for the construction and operation of the road so as to include the lands necessary for depots, wharves, etc., within the City of New York and Jersey City. It limits the first-class passenger fare from Washington to New York to $5; provides that the charter shall not be sold, transferred or assigned to any person or corporation, and directs the company to begin the construction of the road within twelve months after the passage of the act. In consideration of the power proposed to be granted to the incorporators, the bill provides that the United States mails shall be transported by the company on its through fast trains between Washington and New York in "not to exceed 6 hours and 30 minutes per trip, for such compensation as the Postmaster General may deem just and equitable." The incorporators named in the bill are John B. Gordon, Joseph A. Jameson, Hugh McCulloch, William A. Wallace, H. M. Hutchinson, George K. Chase, Noah L. Jeffries, John A. J. Creswell and A. E. Davis.

New Illinois Railroad.—Articles of incorporation of the Carbondale Connecting Railway Company were filed June 24, in the office of the Secretary of State. The object is to build a railroad from Carbondale to connect with the Carbondale & Shawneetown and Illinois Central Railroads. The capital stock is $10,000.

A New Road.—A new railroad is to be constructed at once from East St. Louis to Chester, Ia., following the bluff through Monroe and Randolph Counties. Men are already engaged in securing the right of way along the proposed route.

Street Railroad.—A street railroad company has been organized at Centerville, Iowa, and incorporated for the purpose of building and operating a street railroad from the Rock Island Depot to the square.

Oregon Short Line.—The Oregon Short Line, now being constructed by the Union Pacific, will open up a new line of travel to the Pacific coast. It leaves the Union Pacific at Granger, Wy. T., 877 miles west of Omaha, and runs nearly in a direct line to Oregon, and will reach Baker City, Or., from where it will have a connection with Portland, over a road being built eastward. On the Oregon Short Line the track is laid for 150 miles, and the road will cross the Utah and Northern 218 miles from Granger. On the 8th inst., rails were laid on the bridge over Snake River at American Falls, and for 2,000 feet beyond that point, and the daily rate of progress since that date has been 1½ miles. At this rate the rails will undoubtedly be laid to Little Wood River in 60 days. The road will be opened for traffic as soon as the distance between Granger and the crossing of the Utah Northern is covered by the rails.

The Sauk Center (Minn.) Northern.—Iron has been laid to the crossing of the Little Falls and Dakota road. The grading on this line was begun only three weeks ago, but it has been pushed with unusual vigor. The road will be completed in time to move this year's crops from the Eagle valley if the weather continues favorable.

New Southern Road.—Articles of incorporation for the Pensacola & Mobile Railroad were filed in the office of the Secretary of State at Montgomery, Ala., a few days ago. The road is designed to run from Tensas, on the Mobile & Montgomery road, to Muscogee mills, on Perdido River, where it will connect with a branch already running out from Pensacola.

Work Begun.—Work was commenced June 26 on the branch road designed to connect the Memphis & Little Rock road at Forest City with the Iron Mountain at Knobel Station. The contract calls for completion by Oct. 1.

Work on the Louisville and St. Louis Air Line Road is progressing very rapidly, and by August 1st it will be ready for operation.

Completing the Survey.—Fort Wayne, Ind., June 26. Surveyors will arrive here this week for completing the survey of an Air Line Road from Columbus to Fort Wayne, to be built for the purpose of bringing coal from Ohio mines and to take eastward Michigan lumber shipments.

Construction Work.—Reports received here yesterday state that the grade in the main line of the Chippewa Valley and Superior Road, as well as the bridge work, will be entirely completed by Thursday of the present week. The track is now within five miles of Reed's Landing, the western terminus. The branch from Durand to Cedar Falls, a distance of twenty-two miles, is well along, and the contractors expect to complete the grading work by the 10th of July. The contractors, Wells, Harrison & Green, who also have charge of the construction work on the Toledo and Northwestern branch of the Chicago and Northwestern Road, projected to run from Eagle Grove to Alton, on the Chicago, St. Paul, Minneapolis and Omaha Line, state that the grade will be finished August 1st. The track-laying has progressed as far west as Peterson, eighty-three miles west of Eagle Grove. They also state that four hundred men and two hundred teams are at work between Schleisingerville and Neenah. This force is being augmented as rapidly as the right of way is being secured. Condemnation proceedings have been begun in many cases.—*Milwaukee Republican Sentinel.*

Increasing its Capital.—The Rio Grande and Pecos Railroad company has filed a resolution of the stockholders increasing the capital stock to $20,000,000.

The St. Louis & Chicago.—The Cincinnati, Indianapolis, St. Louis and Chicago management has decided upon extensive improvements in the valley of Tanner's creek, the scene of the late disastrous wash-outs. In addition to relocation of portions of the track, the road-bed over a distance of 14 miles will be raised from 5 to 10 ft. where necessary, in order to get out of reach of the freshets. The damage done recently will reach at least $100,000, according to Supt. Sherwood's estimate. The right of way for the relocated line has been secured by condemning needed property.

The Eureka Springs (Ark.) Road.—Officials connected with this road are actively engaged in getting a full force of graders, masons and other workmen in readiness to push the work with all possible vigor, so as to complete the line at an early day.

The Missouri Pacific Board.—A consolidated mortgage bond given by the Missouri Pacific Railroad to John F. Dillon and E. D. Ames, as trustees, has been put on record in Atchison County, Kansas.

The New York, West Shore & Buffalo railroad has issued orders to all the contractors along the line that their work must be completed by November 1 next. It is stated that there are at present employed on West Shore work 35,000 laborers, nearly 800 civil engineers, 600 steam drills and 21 locomotives, at a daily expense of $100,000.

To Lay Rails.—The Milwaukee & Lake Winnebago Company will commence laying rails between Neenah and Schlesingerville next week.

The Council Bluffs Line.—The track of the Council Bluffs division of the Milwaukee & St. Paul entered Manning, Tuesday. Two miles a day are being laid from the east, and one from the west, and in about ten days the new trunk line across Iowa will be completed. The road is rapidly being pushed to first-class condition, and the ballasting will be mostly finished by the 1st of August. Grading will be commenced on the Defiance line to Sioux City in a short time.

Heading for the Turtle Mountains.—A note from Larimore, D. T., says: "The work of grading the Manitoba line from this place to the Turtle Mountains has been commenced in dead earnest by Langdon & Co., contractors. They already have a large force of men and teams on the ground, and more are arriving on every train. They have erected a large supply store here, and will make this their headquarters for the summer."

Contracts on the W., I. & N. Road.—Superintendent Woolston, on his return to Marshalltown, Ia., from New York, was authorized to let contracts for grading and bridging 100 miles of the Wisconsin, Iowa & Nebraska road.

CONTRACTS LET.

Work on Government Building at Philadelphia.—Supervising Architect Hill has let the contract for iron-work, furring and lathing to J. W. Hoyt of Springfield, Mass., for $34,000. There were 12 bids, the highest being $12,000.

A Chicago Contract Let.—The contract for the foundations of the new Board of Trade building was awarded to E. Sturtevant, for $18,975. The Board furnishes the timber and broken stone and cement for the concrete. The contractor furnishes the sand and 26,000 cubic ft. of dimension stone and does all the work, which he agrees to complete in 36 working days. There were fourteen bids, ranging from $27,000 to $18,300. The latter figure would have been accepted, but the contractor declined to bind himself to complete the work in the time specified.

A Stone Contract Let.—Prairie du Chien, Wis., June 21.—The largest contract ever entered into in this section was concluded in this city yesterday evening between Edward Darragh, contractor, and Col. Smith, chief engineer of the Minneapolis Union stone arch bridge, and Thomas Marsden of Bridgeport, this county. The conditions of the contract are that Marsden shall furnish the stone necessary so that five or more car loads each day will be loaded for shipment at the quarry until December 15th next. The stone from this quarry is of the quality known as the Wisconsin River marble, and is the best in the country for building purposes.

Street Contracts Let.—A dispatch from Toronto says: The following tenders for roadways were accepted, and the contracts awarded: Lingard street, A. W. Godson, at the annexed terms: pavement per yard, 95c.; curbing per ft., 25c.; cast-iron platforms, $2.28 per 100 lbs. Harbord street, R. Dennis, pavement per yard, 99c.; curbing, 27c.; cast iron, $2.50. Henry street, Ardagh & Leonard, pavement, 95c.; curbing, 27c.; cast iron, $4; sidewalks, $23 per 100 ft. Bellevue avenue, also Ardagh & Leonard, pavement, 95c.; curbing, 25c.; cast iron, $4. Parliament street, A. W. Godson, pavement, $1.22; curbing, 25c.; cast iron, $2.25; railway track, $20 per 100 ft.

Jail Contract Let.—The following bids were received for the erection of a county jail at Maysville, Ky., on June 22: Julian W. Hinkle, of Indianapolis, Ind., $31,700, yard wall at $9 per lineal foot; Crumbo & Melcher, of New Albany, Ind., $40,290.80, yard wall, $18.30 per lineal foot; I. M. Lam & Co., of Maysville, Ky., $45,998, yard wall, $18.50 per lineal foot; E. J. Hodgson, of Indianapolis, Ind., $32,200, yard wall at $8 per lineal foot. The contract was awarded to Mr. Hodgson.

Jail Contract Let.—The contract for the new jail and jailors' residence at Jackson, O., has been let, Edward F. Mitchell getting the iron work for $9,800, and W. W. McCoy, of Marietta, getting the stone and brick work for $10,100.

Birmingham, Ala., is to have another compound condensing pumping engine from the George F. Blake Manufacturing Company, a contract having been signed last week for the duplicate engine.

Street-Cleaning Job in Buffalo.—Buffalo, June 26.—Mayor Cleveland to-day returned to the Council, with a severely-worded veto Message, the resolution recently adopted by that body to award the street-cleaning contract to a bidder at $109,000 above the bid of other responsible parties. The contract was then awarded to the lowest bidder.

The Hinsdale (Mass.) Bridge Committee has contracted with Whitlock & Power, of Hudson, N. Y., for an iron bridge to cross the river between F. B. Cook's store and the post-office. It will be 62 ft. span, with 18 ft. roadway, and two sidewalks 5 ft. wide, and will cost $1,500. The abutments are to be built by Brown & Kiley, of Northampton, for $1,050, conditionally.

BUILDINGS.

The New Depot at Lenox, Mass., has been commenced and will be completed in about two months. It will be 41 by 21 feet, with two waiting rooms, ticket office and baggage room, and a side track will be laid there for freight business.

New Post Office for Williamsport, Pa.—Under a suspension of the rules the House passed a bill, appropriating $100,000 for general government offices at the above mentioned place.

Hopkinton, Mass., votes $13,500 for a new town hall.

LABOR.

Brick Masons of Council Bluffs, Ia., have united in demanding $5 per day.

Strike in the Mines.—It is reported that the Clearfield, Pa., miners have decided to strike.

Trackmen Striking.—On June 25 200 Erie Railroad trackmen struck.

The Street Pavers of Baltimore have struck for an advance of from $3.50 to $4 per day.

The Strike of the freight-handlers in this city has seriously delayed freight. The result cannot be foretold, and if the dissatisfaction spreads to other branches of railroad employés the effect upon transportation will be most serious. The men demanded an advance of from 17 cents to 20 cents per hour.

Sixteen thousand men are now employed in railroad construction in Florida.

N. Y. Boiler Makers.—The strike of the boiler makers of this city has ended. The men secured an advance of 10 per cent., or from $2.60 to about $2.86 per day.

Strike of Baltimore Pavers.—The granite block street pavers employed by the City Commissioners and those employed by contractors on city work struck for increased wages. They receive now $3.50 per day for ten hours' work, and demand $4 per day.

Labor is scarce in many sections of North Carolina.

BRIDGES.

Another Mississippi River Bridge.—A Washington note states that Mr. McCoid, of Iowa, has secured the passage of a bill authorizing the Rock Island & Southwestern Railroad to build a bridge across the Mississippi River at New Boston, Ill.

The Pontoon Bridge across the Mississippi at Wabasha, Minn., will be ready for service by July 10.

The Red River Bridge.—The machinery for the construction of the railroad bridge over Red River arrived at Shreveport, La., June 21, on the steamer Jewell, and work will be commenced soon.

Charlestown Bridges.—The commission appointed to consider the most practicable method of providing adequate bridge facilities between Charlestown and the city proper have, it is said, reached a conclusion and will submit a report to the City Council in about a week. The plan agreed upon, it is understood, contemplates the erection of an elevated bridge at a point near the present Charles River bridge, and the widening and otherwise enlarging of Warren bridge. The latter structure is considerably out of repair, and within a few years would have to be substantially rebuilt; and in view of the extensive amount of traffic which daily occurs to and from Charlestown in consequence of the increased railroad terminal facilities, the present time is deemed the best to make the changes in this bridge. The present width of the bridge is forty feet, and it is intended to make it eighty feet in width, which will furnish ample accommodations for many years to come. The cost of the improvement is estimated at about $400,000. The elevated bridge is considered a necessity in order to provide for light teams and horse-car travel which is now frequently interrupted in crossing the tracks of the Fitchburg Railroad, over which a large number of trains are passing daily to and from the wharves owned and controlled by that company. The approach to the upper part of the bridge on the Charlestown side will be near City square, and as the highway will be above the railroad tracks it will obviate the difficulties now encountered. The lower deck of the bridge will be used for heavy teams which cannot ascend the grade necessary to reach the upper section, and by furnishing ample accommodations for the two classes of travel alluded to, it is expected that all wants will be met for a quarter of a century at least, if not for a longer period. The cost of an elevated bridge would be in the vicinity of $1,000,000.—*Boston Journal.*

A Missouri Bridge.—The work of rip-rapping the Hannibal bridge piers began yesterday, under the supervision of Chief Engineer Gill, of the bridge. There will be about 600 yards of rock put around the piers.—*Hannibal Journal.*

Illinois Bridge.—The people of Lacon have made a bargain to build a bridge over the Illinois for $15,000. The bridge has a pontoon draw.

MISCELLANEOUS.

Scotland comes to Michigan for oak for its railway cars.

Leveling Between New York and San Francisco.—A government surveying party is now in Daviess County, Ind. They are engaged in taking the level of the country, on a line as nearly due east and west as they can conveniently between San Francisco and New York. They make about six miles per day, this hot weather.—*Western Exchange.*

ENGINEERS AND ENGINEERING IN OTHER LANDS.

Translated and Prepared from our Exchanges]

It is very unfortunate for engineering projects just at present that there exists such political jealousy among the nations. There was every prospect of having a regular "tunnel-mania." But the military have almost crushed out the project of a tunnel between England and France, while the Egyptian question threatens to interfere for some time with a great many undertakings in the Orient. Some of the Spanish generals are also opposing the tunneling of the Pyrenees, but here, at least, they are not likely to meet with much success. Such proceedings as these do not certainly merit the title of "civil" engineering, in more than one sense of the word.

News from Panama continues favorable, a great many Blacks and Chinese continue to arrive, and villages are springing up. It would be hard, however, to understand why one of them should be termed "Monkey Hill;" it doubtless indicates the presence of some irreverent American who is a believer in the Darwinian theory. More than 1,200 soundings have been made in the Bay of Colon, and the currents, winds, tides, etc., have been carefully studied. The question of the outlet on the Pacific is now in order, but the damming of the Gamboa will offer a great many difficulties. The expenses up to June, 1881, were some forty million francs. However, the immense success of the Suez Canal ought to have a cheering effect on the Panama men. The receipts in 1881, were 51,274,352 francs, while even in 1880, the best previous year, they amounted to only 39 millions.

The question of deepening the Seine is still discussed by our French *confréres.* Very contradictory plans have been presented. That of M. Frimot is to have a series of ten dams, so as to raise the level, and then to dredge the shallow places. Here, however, difficulties come in, the dams are likely to increase the inundations in times of freshets, but it is thought that the moveable dams as suggested by Poirée and Boulé will completely overcome this objection. Rivers are divided by M. de la Grye into three categories; those which carry along with them a quantity of matter torn from their banks; those which simply change their beds; and those which have but a slow current and carry along little or nothing. He classes the Seine in this last category, and he maintains that the bed of such a river is sinuous. This view is not accepted by M. Cotard who believes the sinuous form is not caused by the absence of drifted matter, but from the weakness of the bed, by which a stream has to lengthen its course until the slope and speed diminishing there is an equilibrium between the action of the current and the resistance of the soil. The project for the Seine as presented is to dredge the river from Rouen to Poissy, so as to create a channel of 45 metres in width at bottom. The scheme presented does not seem to solve the problem, and it was objected that the result of such a drain would be most injurious to agricultural interests. The system of sluices, which are to be all concentrated at Poissy, does not appear to be very practical.

Most of us remember the great inundation a few years ago, which almost completely destroyed the city of Szegedin, the most important place in Hungary after Pesth. The new bridge to be built over the Theiss and which was to cost altogether some 2,600,000 francs was the subject of a lively competition. The length of the bridge was to be 375 metres. Twelve houses put in 23 plans and bids. Paris, Brussels, Amsterdam and other places competed, but the committee unanimously adopted the plan of a bridge with arches of M. G. Eiffel of Paris. The land abutment and the principal pier in the river will be laid by means of compressed air at a depth of 18 metres below low water mark.

ARTIFICIAL BLOCKS OF MASONRY.

Artificial ashlar work has been largely used in the port of Finme, which has lately become such a rival to Trieste. The blocks used were uniformly 3 metres 70 cent. in length; 2 metres in width, and 1 metre 50 cent. in height (Fig. 1). The interior cubed 11 metres 10 cent. was built with rubble stone, but the front facings were of cut stone of a maximum weight of 10 kilos. Each block weighed from 26,000 to 27,000 kilos. They were allowed to dry three months before using, in summer two months only. It is necessary that dessication should not be rapid, and at the beginning the blocks should be watered twice, and afterward once a day. The strength of the material is tested in the following way. One of the blocks was placed after 83 days on rails *a, b, c, d,* which caught into grooves made on lower face (Fig. 2). The rails were supported by wooden posts about 2½ feet in height. The earth was then taken away from beneath, so as to leave the block entirely free. It was then overturned by means of screw-jacks. When the block fell, its corner D struck the ground obliquely, and sunk into it Fig. 3, and a fissure *o, p, q,* of one millimetre in width was produced. A second cleft *r, s,* was just observable on the lateral wall. The block was left some time, and then broken up to ascertain the injuries inside. The masonry was found perfectly dry, and the defects solely attributed to the quality of the material used. Of 3,794 such blocks used in the port only some 19 were found imperfect. The cost was far less than for blocks of Portland Cement, those of that kind used at Cherbourg, Port Said, and Trieste cost respectively 55, 42 and 28 fr. per cubic metre. The Fiume blocks cost only 20 fr. 50 cent. per cubic metre.

FIG. 1. FIG. 2. FIG. 3.

* * *

SPECIFICATIONS OF THE METROPOLITAN BOARD OF WORKS.

PAVING, &C., IN HORSELYDOWN AND BERMONDSEY.

This specification refers to works to be done in Freeschool street and Thornton street, New street and Fashion street, St. John, Horselydown, and in Jamaica road, Bermondsey, in the County of Surrey.

The works comprise the formation of paved carriage-ways and foot-ways, &c., as per drawings, Nos. 1, 2 and 3. Also, the maintenance of the whole of the same in thorough repair for 12 months after completion.

The ground on one side of Freeschool, Thornton, New and Fashion streets, and Jamaica road, Bermondeley, up to the proposed new frontage lines shown on plans is, without extra charge, to be raised or filled up with dry rubbish, gravel or other material, of approved quality, well watered and punned in layers; or reduced to the levels shown upon the drawings, and to the widths required. Previous to laying the foot-ways and the concrete foundations of the carriage-ways the ground shall, as part of and included in the contract, be reduced to uniform surfaces at the proper level by filling or excavating, as the case may be; and in the former case the filling shall be formed of brick rubbish or gravel, or such, if any, material excavated from the site of the works, or such other as may be approved by the engineer. In all cases the materials used for filling in shall be well watered, and afterwards punned or rolled, as may be directed by the engineer, so as thoroughly to consolidate the ground to his satisfaction previously to laying the concrete and paving. All vaults shall be broken up, and all cavities or open spaces filled in and solidly rammed. From the "Three Compasses" P. H., along the main thoroughfare to Dockhead as shown upon the drawings, a line of tramway is to be formed by the contractor. The whole of the iron work for this, as shown upon drawing No. 3, will be supplied by the tramway company; but the rails are to be laid, and all other materials and labor supplied, by the contractor; this part of the work being done to the satisfaction of the engineer to the tramway company, and in accordance with the following conditions: The rails are to be laid to true curves, being bent and straightened, where necessary, by crowing, and not by hammering. Any rivets which may be loosened by crowing the rails shall be cut out and replaced. All joints to be brought fair and true, and to have steel shoes, as shown on drawing. Cutting the rails, except at the proper position with respect to the pitch of the rivetting, is to be avoided; but where unavoidable the rails are to be fished to the satisfaction of the engineer. The rails are to be laid to such gradients as may be required by the fall of the road, and shall be bedded on fine concrete, composed of one part of Portland cement to one part of screened Thames ballast. The bedding is to be perfectly solid under every part of the rail, and to ensure this, beating hammers of approved form should be used for packing. When the rails are bedded the whole surface of the concrete shall be made up with similar fine concrete to within half an inch of the extreme depth of the stones below the finished level of the surface. The rails shall be laid to a gauge, the particulars of which shall be supplied by the engineer, and a standard gauge bar shall be prepared for the engineer's use, and left in his charge during the progress of the works. The paving between the outer rails shall be of Guernsey granite sets of. 7 in. in depth and 4 in. in thickness, no stone being longer than 12 in. During the progress of the paving the rails shall be kept in place by temporary tie bars of Tee iron about 3 in. by 2½ in., with notches in the web to fit the heads of the rails, which should be placed about 8 ft. apart, and removed as the paving proceeds. The finished level of the paving adjacent to the rails to be about a quarter of an inch above them.

The carriageways, being 7,245 superficial yards, shall be formed of Aberdeen or Guernsey granite cubes or sets, 7 in. in depth and 4 in. wide on bed, carefully dressed and free from protuberances on surface, laid to a uniform surface on a bed of Portland cement concrete, 9 in. thick, and being 2,060 cubic yards, the surface of both granite and concrete being formed as may be directed. After this bed of concrete has set hard, the cubes or sets are to be bedded on a thin layer of Portland cement concrete spread over the concrete foundation, laid in regular straight courses, and properly bonded and toothed into each other, so close at joints that six courses, when laid and finished, shall not measure more than 27 in., leaving only sufficient space for grouting to pass to the bottom; to be well rammed, and back rammed as directed by the engineer, to a uniform surface, and well grouted with sharp sand and Portland cement in the proportion of four to one, and coated with fine hoggin. The crossings, being 208 superficial yards, shall be of granite cubes, the same as the carriageways, but specially dressed for crossings, laid in the same way as the ordinary paving, having the same curvature as the carriageway across which they are laid. As the local traffic must be kept uninterrupted, it will only be possible to pave one side at a time, except in Freeschool and Thornton streets.

The channels, 3,650 ft. in length, shall be formed of Guernsey granite stones, 7 in. deep and 12 in. wide; no stone to be less than 2 ft. 6 in. in length, all laid on a bed of Portland cement concrete, as shown; the stones to be worked fair on upper surface, equal to sample, with joints squared throughout the whole depth or thickness, closely laid and well grouted with Portland cement, as before specified, as the work proceeds. The channels to be laid with a fall towards the gullies, as may be directed. The kerb (which is partly curved, as shown on the plan) for margin to the footway paving, 3,510 ft. in length, shall be of new Aberdeen or Guernsey granite laid in cement mortar on a bed of Portland cement concrete. The stones to be 8 in. deep and 12 in. wide on bed, to be worked fair and fine, dressed on two faces equal to sample.

The heading joints to be neatly squared through for their entire depth, and the back joints with York paving to be squared for a depth of at least three inches. No stone to measure less than 3 ft. in length. The footway paving to be specially rounded at curves, as directed and the kerbstones shaped to correspond. The footway paving 32,490 ft. sup., shall be of new 3-in. York stone, sound and hard, and of a uniform and close texture, free from sand holes and other defects, and to dry after rain of a light color, as nearly as possible uniform throughout. The flags to be of full thickness throughout, thoroughly tooled to a fair, clean, level and true surface, equal to sample, and the joints tooled square. The stones to be laid in lias mortar on a sufficient bed of fine sand, gravel, or other approved material, with close and neat joints, and in uniform courses, breaking bond, the courses of new paving to be at least 1 ft. 10 in., and not more than 2 ft. 9 in. wide, no two adjoining courses to differ in width more than 3 in., and no new stone to be of less area than 5 ft., except for such closers as may be allowed; the joints to be dressed and rubbed down after laying, where necessary, to preserve a uniform surface throughout. The paving to be laid with slope toward the carriageway.

Wherever the new works intersect with or end in the existing streets or places, the whole road and footway works shall, without extra charge, be taken up and relaid to such extent as the engineer may consider necessary, and the best of the old materials taken up in any part of the work are to be used therein. Where the levels of the existing footways are to be altered, the contractor will have, without extra charge, to alter the levels, the area gratings, railings and kerbs, and the steps and landings giving access to the premises in such manner as may be directed.

The contractor shall provide and lay 250 ft. run of 15-in. pipe sewer, bedded on Portland cement concrete in accordance with cross-section No. 4, including twenty junctions extra on. Also 3,100 ft. run of 6-in. stoneware pipe sewer without a concrete bedding therefor. The above lengths of pipes to be distributed as indicated on the drawings, or in any manner the engineer may direct, including making good connections of existing drains with existing brick sewers and proposed sewers. Also shall supply and fix within the existing sewers, in accordance with directions which will be given by the engineer, eighty 6-in. and one 15-in. galvanized iron tide-flaps similar to samples. Thirty-six gullies to be formed in brickwork in cement, with syphon traps and connected with the sewer by 6-in. stoneware pipes, which are included in the pipes provided. The gullies to be fitted with cast-iron gratings, to be supplied and fixed by the contractor (see Drawing No. 1).

The contractor shall provide and erect 18 new substantial cast-iron street lamps in such situations on the works as the engineer may direct, either to same design and dimensions as those now in the locality, or, to some other as shall be ordered, including copper lantern properly glazed, with copper door and ventilator to same, and ladder iron to each lamp, and shall shift, as may be directed, the existing lamps, six in number, and make good the connections with the service pipes. The whole of the said street lamps, new and old, are to be painted in four oils, finished, bronze color and furnished (in manner to be approved) with gas pipes, burners, and fittings. The gas piping to be provided and laid by the contractor, is to extend from the burners to the bottom of the street lamps, and thence to the main, with which it is to be connected. The contractor will have to supply the necessary bends, unions, nipples, and Tee pieces, and to leave the lamps complete and ready for lighting. The whole of the work to be executed in the best style of finished workmanship.

The pipes, bends, junctions, and drain-mouths shall be of the best stoneware, to be approved by the engineer, well burnt, salt-glazed, circular, perfectly true in bore, and straight, with whole socket joints, free from flaws, blisters, cracks, and other defects. Those of 12-in. or greater diameter are to be at least 1 in. in thickness. All junction pipes shall be molded with a proper curve. All the stoneware pipes shall be jointed with neat Portland cement, and laid by a bricklayer; and all materials and workmanship shall be of the best quality, and equal to samples to be seen at the offices of the board at Spring-gardens. All the surplus earth, rubbish, carriage and footway paving-stones, kerbing, or other old materials, not being private property, or claimed by the board for use in the proposed works, are to become the property of the contractor, and are to be carted away. The area of the present carriage-ways is about 4,750 yards superficial; and of footway paving about 17,900 ft. superficial. The present kerbs about 3,400 ft. in length, 12 in. by 6 in. on edge, and 300 ft. in length of 12 in. by 8 in. laid flat. If any of the existing road or footway paving is permitted to be used instead of new, only the labor of taking up, dressing and relaying is to be allowed for to the contractor. The existing boarding and fencing are not to become the property of the contractor, but to be removed as occasion requires, and to be deposited and stacked in such portion of the vacant ground along the line of works as may be directed.

The lime that may be required to be used in any part of the works shall be obtained from the lower or hardest beds of the blue lias formation, of quality equal to the best Aberthaw or Lyme Regis, brought in lumps fresh from the kiln. The lime to be turned over and wetted from the rose of a watering-can, covered up with sand, and allowed to remain till cold; then sifted through a fine sieve; about two and a half of sand is then to be added to one of lime and made into mortar, which is to remain for at least 24 hours before being used.

The whole of the cement for these works, and herein referred to, is to be Portland cement of the best quality, ground so fine that the residue on a sieve of 5,800 meshes to the square inch (equal to about 76 per lineal inch) shall not exceed 10 per cent. by weight. When tested, should the proportion which will not pass through this sieve be greater, a quantity of cement proportionate to such excess must be added. When brought upon the works it is to be put into a dry shed or store, which the contractor has to provide for the purpose, having a wooden floor and all necessary sub-divisions. The cement is to be emptied out upon this floor, every 10 tons being kept separate, and is not to be used until it has been tested by samples taken from different sacks. The cement is to be gauged with three times its weight of dry sand which has been passed through a sieve of 400, and been retained upon one of 900 meshes to the square inch. A sample of this sand may be seen at this office. The cement and sand having been well mixed, dry, about 10 per cent. of their weight of water is to be added, and briquettes formed in moulds of 1-in. sectional area at the weakest part. The briquettes, having in the meantime been kept in a damp atmosphere, are to be put into water twenty-four hours after they have been made, and remain in water until their tensile strength is tested by means of apparatus belonging to the board, and by their officers. The cement, neat, must not, at any season of the year, set in less than one hour, and must bear, without breaking, a weight of 300 pound per square inch 28 days after the briquettes have been made. If it does not, it will be rejected, and must be forthwith removed from the works. To secure due progress the contractor shall, immediately after the contract is signed, procure and deliver onto the site of the works a stock of cement sufficient for carrying upon works for at least five weeks, and at all times, until their approaching completion, shall keep stored on the works a quantity equal to five weeks' consumption. All cement concrete to be used throughout the works, with the exception of that under the tram rails, to be formed of one measure of Portland cement to eight measures of ballast. All lime concrete to be formed of one measure of lime to six measures of ballast. The whole to be thoroughly mixed and put into the works as may be directed.

The works are, without extra charge, to be carried on day and night without intermission should bad or treacherous ground be met with, or should there be any other cause whatsoever which in the judgment of the engineer shall require it. The contractor to provide, fit up and shift from one section of the work to another during the progress of the work, as shall be directed, a large, movable office for the accommodation of the clerks of the work, with all requisite fittings, stoves, firing, lighting, etc., so as to be habitable for working purposes at all times and under all circumstances; and at the completion of the work it shall become the property of, and be removed by, the contractor, who is also to supply the necessary laborers to attend the same, and to assist the clerk of works in taking levels, etc. The contractor to include in tender (in addition to all other things specified therein), and to provide the sum of £500 to be expended or used, either wholly or in part, or not to be used, at the discretion of the engineer, and entirely as he may decide and direct, but if no part, or only parts thereof, are used, then the whole, or the parts not used, shall be deducted from the amount of the contract; and in like manner any increase thereof shall be added to the said amount, and such works shall be deducted from or added to the amount of the contract in accordance with the terms specified in Clause 32 for regulating such diminished or extra works, or otherwise, as herein provided. Within seven days after the contract shall have been executed, the contractor shall deliver to the engineer full and true bills of quantities, with the rates of charge and the amounts of each item, and the total amount upon which the tender was based; and upon refusal or neglect to do so shall forfeit to the board £10 per day for every day that such refusal or neglect shall continue beyond the period specified, each sum to be deemed liquidated damages.

The contractor shall return to the custody of the engineer, at the time of the delivery up to the works of the board, and before he receives the instalments payable thereon, all plans, drawings, writings, papers, specifications and documents which may have been delivered to him, or for his use; and, in the meantime, the engineer, and such person as he may appoint, and the assistant engineer and clerks of works, shall have full access thereto at all times and for all purposes, and the same shall be kept at or near the site of the works. All coins, or other articles of antiquity or value, which may be discovered in the course of these works, shall be immediately delivered into the custody of the engineer or other officers on behalf of the board.—*The Contract Journal of London.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES M. AM. SOC. C. E.

(*Continued from page* 218.)

CCCXLVIII.—NEW BRITAIN.

New Britain, Connecticut, in lat. 41° 40' N., long. 72° 48' W., was incorporated as a borough in 1850, and as a city in 1873.

Water-works were built by the borough in 1858 after plans of McRee Swift, C. E., A. Chamberlain being the resident engineer, taking the supply from Shuttle Meadow Brook, which has a water-shed of about one square mile. A stone dam forms a storage reservoir of 175 acres area, holding 700,000,000 gallons, at 175 ft. above the city. A distributing reservoir was built on a hill near the centre of the city.

Distribution was at first by wrought-iron and cement pipe, a large portion of which has been from time to time replaced by cast-iron pipe. There are 25 miles of pipe of from 12 to 4-in. diameter, with 153 fire hydrants, 1,350 taps. There are 56 meters in use. The city contributes $25 per year for each hydrant. Service pipes are of wrought iron. The population in 1880 was 13,937. The daily consumption is 3,000,000 gallons.

The works have cost $225,000 and the bonded debt is $190,000 at 6 and 7 per cent. interest.

The expenses in 1881 were: For maintenance, $3,017.80; for interest, $11,970.00; and for extensions, $2,049.26. The receipts were $16,627.89.

The works are managed by three water commissioners.

CCCXLIX.—ELMIRA.

Elmira, New York, in lat. 42° 5' N., long. 76° 58' W., on the Chemung River, is in a narrow valley, surrounded by hills.

Settled in 1787 by emigrants from Pennsylvania, it was incorporated as a city in 1864.

Water-works were built by a private company in 1861, after plans of Alphonse Fteley, C. E., R. M. McDowell being the resident engineer. The supply is taken by gravity from Carr's Creek, which has a water-shed of 4½ square miles. The storage reservoir of 26 acres area and 100,000,000 gallons capacity at 210 ft. above the city is formed by an earthen dam on Carr's Creek 1,100 ft. long and 36 ft. high, 10 ft. wide on top and paved with stone on the inner slope. A canal 25 ft. wide is constructed along one side of the reservoir to carry off surplus and turbid water. A 16-in. cast-iron pipe conveys the water through the dam, and thence a 12-in. wrought-iron and cement pipe extends 4,500 ft., when the water is discharged by a fountain-jet into the distributing reservoir, which is built in excavation and embankment, with its inner slopes paved, is 300 ft. square and 90 ft. above the city. Additional supply from near the Chemung River is obtained from a filter gallery 5 ft. wide and 216 ft. long, in gravel, 100 ft. from and parallel to the river. This yields about 1¾ million gallons per day. The water is pumped 90 ft. to the distributing reservoir by a Knowles pump of 3,000,000 gallons daily capacity, erected in 1880.

Distribution is by 34 miles of pipe, some of cast iron and some of wood, of from 12 to 4-in. diameter. There are 146 fire hydrants, 800 taps and 176 meters. The city pays $75 per year for each of 80 hydrants, and $50 per year for each over that number. Service pipes of galvanized iron are used.

The population in 1880 was 20,541. The daily consumption is 1,400,000 gallons.

The works have cost $345,000. Further financial statistics are not given.

A. Diven is the Superintendent.

CCCL.—CHARLOTTE, N. C.

Charlotte, North Carolina, in lat. 35° 15' N., long. 80° 46' W., is on slightly undulating ground, on Sugar Creek. It was settled in 1762 and incorporated as a city in 1850.

Water-works were built by a private company in 1881-2 after plans of S. E. Soper, taking the supply from a number of springs, the water from which is impounded by a dam of clay with timber heart, forming a reservoir 600 by 150 ft., and 16 ft. deep. It is 120 ft. lower than the city. The water is pumped into a stand-pipe 18 ft. in diameter and 80 ft. high, in the city.

Distribution is by 5 miles of cast-iron pipe of from 12 to 4-in. diameter, with 40 fire hydrants, 9 gates and 30 taps. The city pays $50 per year for each hydrant. Service pipes are of lead.

The population in 1880 was 8,612. The consumption is not determined yet.

The capital stock of the company is $100,000, and the bonded debt is $100,000, at 6 per cent. interest.

Garwood Ferris is the Superintendent.

CCCLI.—PIQUA.

Piqua, Ohio, in lat. 40° 7' N., long. 85° 13' W., is on the Miami River. It was setled about 1800. In 1856 the Miami Hydraulic and Mining Company was formed, which purchased from the State of Ohio the Lewiston reservoir and a part of the Miami and Erie Canal and enlarged the reservoir, building an embankment 4 miles long and 25 ft. high in places. The reservoir and water power thus formed were repurchased by the State in 1858. In 1865 the Piqua Hydraulic Company was formed to utilize this power and supply water to the city, but failing to fulfill its contract, the city in 1875 purchased all its rights and constructed water-works.

The Lewiston reservoir, 46 miles from the city, at a point where several streams unite to form the Great Miami River, covers 9 square miles and furnishes available storage 14 ft. deep. The water flows in the river channel 27 miles to Port Jefferson, where a dam directs it into a feeder canal 13 miles long, to Lockington, whence the "hydraulic canal," 6 miles long, leads to the water-works. Franz Pond of 6 acres, Versailles Pond of 23 acres, and Swift Run Pond of 56 acres, also feed the hydraulic canal. There are three water powers, respectively of 20 ft., 17 ft. and 13 ft., head and fall. The pumping machinery comprises two double-acting Flanders pumps of 14-in. bore and 20-in. stroke, driven by Ross Turbine wheels, one 24 in. for domestic and one 48 in. for fire supply. The water is pumped directly into the mains with 90 lbs. fire pressure. Distribution is by 9 miles of cast-iron pipes of from 12 to 4-in. diameter, with 60 fire hydrants, 30 gates and 450 taps. For ordinary purposes, the canal, which is 85 ft. above the city, furnishes water without the intervention of the pumps. Service pipes are of galvanized iron.

The population in 1880 was 6,817. The daily consumption is 180,000 gallons.

The works have cost $80,000 besides the $300,000 paid for the canal and water rights. The bonded debt is $290,000 at 6 and 8 per cent. interest. Further financial statements are not given.

The works are managed by three trustees. J. W. King is the Secretary.

CCCLII.—SALINAS CITY.

Salinas City, California, in lat. 38° N., long. 121° 45' W., in the Salinas Valley, was settled in 1868, and incorporated as a city in 1874.

Water-works were built by a private company in 1873, taking the supply from 3 artesian wells of depths of 80, 200 and 234 ft., and pumping the water by a 10-in. Knowles pump into three tanks, two of these containing 90,000 gallons, at 45 ft. above the city, for domestic use, and one holding 40,000 gallons, at 75 ft. elevation, for fire purposes. A second Knowles pump is provided for fire pressure.

Distribution is by 5 miles of cast-iron pipe of from 6 to 3-in. diameter, with 22 fire hydrants and 12 gates. The number of taps is not given. The city does not pay for fire-hydrant service. Wrought-iron service pipes are used. The population in 1880 was 1,600. The consumption is not given.

The capital stock of the company, which supplies both gas and water, is $60,000. There is no debt. Further financial statements are not given.

J. B. Iverson is the President, and J. P. Lauritzen, Superintendent.

CCCLIII.—WESTCHESTER, PA.

Westchester, Pennsylvania, in lat. 39° 58' N., long. 75° 35' W., is on an elevated ridge between Brandywine and Chester Creeks, and about two miles from each.

It was settled in 1780, and incorporated as a borough in 1789.

Water-works were built by the borough in 1841, taking the supply from Bath Springs, near the town, and pumping it through 4,800 feet of 8 and 6-in. cast-iron pipe into a reservoir.

In 1854 an additional supply was obtained from Chester Creek, 2 miles from the town, and pumped into the reservoir through 10,560 ft. of 6-in. pipe. A basin 125 ft. square is formed at the pump works, from which the water is taken in time of freshets or when the stream is muddy. When clear, the supply is taken directly from the creek. In 1881 an additional 12-in. force main was laid, and a new reservoir built, 150 by 175 ft., and 14 ft. deep. It is 91 ft. above the pumps, and from 35 to 100 ft. above the town. These works were built after plans of Isaac S. Cassin, C. E.

Distribution is by 11 miles of cast-iron pipe of from 12 to 4-in. diameter, with 90 fire hydrants and 1,000 taps. Lead service pipes are used.

The population in 1880 was 7,043. The daily consumption is 200,000 gallons.

The works have cost $100,000. The bonded debt is $95,000.

No separate account is kept of the expenses of maintenance. The receipts in 1881 were $11,000. The works are managed by a committee of three members of the Common Council, appointed by the Chief Burgess.

J. B. Wood is the Chief Burgess, and Charles Henry the Superintendent.

[TO BE CONTINUED.]

The receipt of statistics, as follows, is acknowledged with thanks: From A. Diver, Superintendent, statistics and water rates of the Elmira (N. Y.) water-works. From J. W. King, Secretary, statistics and report of water-works of Piqua, Ohio. From W. W. Flemming, Attorney, statistics and water rates of the water-works of Charlotte, N. C. From J. B. Iverson, President, statistics and water rates of the water-works of Salinas City, Cal. From the Water Commissioners, 25th annual report of water-works of New Britain, Conn. From the Water Commissioners, report of the Holyoke (Mass.) water-works for 1881. From R. J. Brough, City Engineer, report of Toronto water-works for 1881.

Letters to Washington, Cal., and San Quentin, Cal., having been returned unopened, it is supposed that there are no water-works at those places.

RICHMOND, VA., WATER-WORKS.

The new water-works of Richmond, Va., were officially opened on Thursday, June 29. From the account in the *Richmond Dispatch* we quote the following description of the works and the ceremonies attending their opening.

The new works are located on the north or bluff bank of the canal at the Three-Mile locks, which are—or rather were, for they are things of the past—three miles from the basin and about two miles from the northern limits of the city. The building which shelters the pumps and wheels is of undressed granite. There are two stories, each of lofty pitch. On the first are the wheels, pumps and all the machinery. The second is to be a grand pavilion. Small spaces on the two floors will be cut off for offices and workshops.

The building is a handsome one.

The wheels are novel. They are vertical turbine. There are three of them, and to each are attached three pumps. The water has a 20-ft. fall, and the works will have a real working capacity of 12,000,000 gallons *per diem*, all of which will have to be lifted to the reservoir, some 4,000 ft. distant, and up a height of 175 ft. These pumps were planned by Mr. C. A. Smith, of St. Louis, and were made by H. A. Ramsay, of Baltimore. In 1880 the city offered $1,000 in prizes for the best three water-works' plans offered. Mr. Smith's was accepted. Colonel Cutshaw has superintended all of the engineering, including the construction of the conduit.

THE WATER-POWER

comes into the conduit from James River at Bosher's dam, or the Nine-Mile locks. The old canal—displaced by the railroad built upon the tow-path—was not sufficient. For the whole distance, six miles, it had to be deepened, widened and straightened, and oftentimes through beds of solid granite. That was a great and costly work, but a necessary one. The city now has all the water-power it will need for years and years to come, and it is believed that it will be little affected by droughts and freshets. The old works were affected by both.

However, the big steam-pump is at hand at the new works ready for all such emergencies. It was built by H. R. Worthington, exhibited at the Philadelphia Centennial in 1876, and bought and erected by the city during the great drought of 1881. It can furnish 6,000,000 gallons per day, which is nearly as much as we now use.

MOST OF THE PROPERTY

on which these works were constructed was acquired by the city from the James River and Kanawha Company, but additional tracts were bought from other parties for building and other purposes, and now we own near 200 acres between the canal and Main street, the whole peculiarly well situated for a public park, and is now being put to that use. So we will not only get new water-works, but out of the water-works appropriation a fine park—a thing we would not soon have gotten otherwise.

At 11 o'clock A. M. the two branches of the City Council and most of the heads of department of the city government left the Alleghany railroad depot on a special train kindly provided by General-Manager Axtell, and under the charge of Captain James Duval. The train stopped a little while at the old pump-house and then went direct to the Nine-Mile locks. There the party inspected Bosher's dam and work done there to enlarge the feeder of the canal. The water had been turned on the night before, and was flowing through the gates in muddy turbulence. From the Nine-Mile locks to the Three-Mile locks the whole line is a record of skillful engineering, hard work, and large expenditure of money.

The object has been to get plenty of power; plenty not only for ordinary times, but for reasons of drought, like that of last summer, and it is believed that that has been accomplished.

Arrived at the new pump-house, the party entered by the western door. They found the wheels and pumps in place and all right, but a good deal of the finishing work yet to be done.

Mr. Keiley having assembled the party about him, expressed for all present and for the larger community whom they represented the delight which the completion of the works afforded. It gave him pleasure, he said, to state as a circumstance somewhat novel in municipal experience that all the work had been done within the first estimate, and that the $350,000 appropriated had been sufficient. He complimented Mr. Charles T. Davis, the chairman of the Committee on Water, for the prudence, patience, zeal and ability which had characterized his administration.

It was now (at 1:05) announced that the pumps were ready to be started. Mr. Davis turned the water on Wheel No. 1; Mr. Keiley on No. 2; and Mr. James Hayes on No. 3, and without hitch or "hesitation" the three great wheels commenced to revolve, the nine pumps were set to work and water at the rate of 12,000,000 gallons *per diem* commenced to go up hill through the pipes to the reservoir.

A collation was then served, after which Mr. Davis, as chairman of the committee, read a statement giving a history of the difficulties encountered and overcome in the building of these works, and expressing his pleasure that as he had introduced the first resolution in relation to the new reservoir, he could announce, as he was about to retire from the Council, that the new works are completed.

In response to calls, speeches were then made by Messrs. A. M. Keiley, Henry G. Cannon, Maxwell T. Clarke, W. H. Williams, J. Taylor Ellyson, W. H. Scott and G. Watt Taylor, in which there were liberal acknowledgements of the city's indebtedness to Mr. Davis and to his committee, and to Col. Cutshaw and his assistants.

About 3 o'clock the proceedings of the day were brought to a close, and the party returned to the city.

Among the gentlemen who were present were J. James R. Croes, civil engineer, New York, and Colonel Warburton, late an engineer officer in the British service.

It is not stated above, but is an important fact not to pass unnoticed, that the water used in turning the water-works wheels flows into the canal below the Three-Mile locks, and comes on to Richmond to turn the wheels of the Tredegar, the Gallego and other mills.

GROWTH OF RAILWAYS.

The *Railway Age*, giving a summary of the railroad building for the first six months of 1882, says: "The totals are astonishing. While only one-half of the year is gone, and that including the several winter and spring months, when the work of construction, particularly in the Northern States, is generally not even commenced, and, while there has been a great cry about overdoing railway building, and many predictions made of impending financial disaster, we find that track has been laid on at least 179 lines, in 37 States and Territories, adding a mileage of main track aggregating no less than 4,990, or, in round numbers, 5,000 miles. It must be remembered that those figures show only the main track, and do not include sidings and second, third, and fourth tracks, of which hundreds of miles have been laid. How extraordinary has been the work of the past season in comparison with its predecessors may be seen by the fact that while it shows nearly 5,000 miles of new road the aggregate reported for the same period last year was only a little over 2,000 miles, and during the same period of no previous year has it equaled even that amount. In all of the Western and Southern States and Territories railway building is being actively pushed, and an examination of the map will show that, except in a few cases, where parallel or competing roads are being built, there is ample room and need for all of these lines, and that many more even must be built before the necessities of the country are supplied. With the present outlook we see no danger of excessive railway building this year. The total railway mileage of the United States is now more than 107,000 miles."

THE WEST SHORE ROAD.—The *Springfield (Mass.) Republican* says: Work on the West Shore railroad, which skirts the right bank of the Hudson, and in which D. D. Warren of this city is one of the heaviest contractors, is being rapidly pushed just now, and it affords entertainment for all tourists on the river. The management paid Mr. Warren $87,000 last month and the work for this month will probably call forth a larger sum.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, JULY 8, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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THE new issues in Van Nostrand's Science Series, will be one on "Railroad Economics," and another on "Wrought Iron Bridge Members," both by Prof. S. W. Robinson, of the State University of Ohio, and a third one, of "Pocket Logarithms" (*4 places*).

A NEW architectural volume recently issued deals with "Interiors and Interior Details," and covers, in fifty-two large quarto plates, a large number of original designs of Halls, Staircases, Parlors, Libraries, Dining Rooms, etc. Together with special designs for Low Cost, Medium and Elaborate Wood Mantels, Sideboards, Furniture, Wood Ceilings, Doors, Door and Window Trims, Wainscots, Bank, Office, and Store Fittings, in Perspective, Elevation and Detail, making a valuable series of Suggestions for Architects and Architectural Designers. The price of this volume is $7.50.

THE JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES for April is received. Its contents are a Theorem of Statics, with some Graphical Applications, by Prof. Chas. A. Smith, Washington University, St. Louis. The Best System for Transit Work, by G. A. M. Liljencrantz, C. E., Chicago. Changing the Gauge of Railroads while in Operation by H. C. Thompson, C. E., Cleveland, O. Tribute to the Memory of A. L. Holley by J. F. Holloway, Cleveland. Proceedings of Engineers Societies in Boston, Chicago and Cleveland. The price of the Journal is 30 cents per number and copies can be had by addressing H. G. Prout, 12 Barclay St., N. Y. City.

THE MEXICAN CENTRAL AT PASO DEL NORTE.

From a correspondent in Paso del Norte we have received several communications containing interesting information concerning the work now being done, and that contemplated. On May 5 the grade of the Mexican Central Railway had been virtually completed to the city of Chihuahua, a distance of 224 miles south, and track had been laid on 157 miles of road; while the contractors were moving on to the first 50 miles south of Chihuahua.

On May 4, the road was opened for business from Paso del Norte to Gallego, 140 miles south, one regular passenger train being run each way daily, also one material train and one freight, besides various specials and extras. The letter states that it begins to look quite business-like. There were at that time six coaches and two baggage-cars borrowed from the Atchison, Topeka & Santa Fé Company, for temporary use until the cars belonging to the Central arrived, several of which were then on the road.

The passenger depot and general office building is of *adobe* and is nearly finished. The plan is that of a hollow square, with a *plazzita* or court in the center, in which there will be two fountains. The long side is 280 feet, parallel to the track; the other side is 186 feet in length. "It will contain some thirty rooms, baggage, ticket-office, lunch-rooms and general offices, viz.: General superintendent office and private office, superintendent of telegraph, superintendent of transportation, cashier's office. The chief engineer will have five rooms." The train dispatcher will occupy a room in the second story, over the arched entrance to the court, furnished with bay window, giving him uninterrupted views both up and down the track, and high enough to be above all obstructions. With the exception of the second story the building is strictly "Mexican in design, and will, with its modern improvement in the interior, be a pleasant change to the weary eye of the American traveler, from the uniform regulation depots of the A., T. & S. F., and the S. P. & T. & P. R. R.'s over the river; something new and interesting to those who may be compelled to wait an hour or two for custom house inspections of baggage, etc."

In regard to other improvements now in progress we quote as follows: "Round-house to accommodate twelve engines is now being commenced. Freight house is nearly completed. Machine shops will soon be started, and I will guarantee that in one year longer Mexicans from the interior, who came here to the bull-fights in December last, would not recognize that portion of Paso del Norte in the vicinity of the railroad grounds. In fact, the advent of a railroad in this ancient town has wrought wonderful changes in all directions. The old merchants who one year ago had solid doors and blinds, now have *modern glass* doors and windows to their stores, and some even became so very extravagant lately as to *drive* wells and have force pumps and hose in front of their stores to keep down the dust."

Another letter received but a short time since states that the depot is progressing very well, considering that all mill work comes from Chicago. It is partly under roof, and all the walls are done. The round house is under way, and will also be of *adobe* with stone foundations. Messrs. Lantry & Burr of Topeka, Kansas, are doing the mason and adobe work.

Regular trains are now run to Laguna, a distance of 165 miles, where stages connect with Chihuahua. By leaving Paso del Norte at 10 o'clock, A. M., the passenger can breakfast at Chihuahua the next morning. Locations have almost been completed to the Durango line.

El Paso on the Texas side is growing rapidly and will, no doubt, make a thriving town, having four roads—the A. T. & S. F., the S. P. R. R., the T. P. R. R. and the M. C. R. R., and one prospective road, the E. P. & W. O. R. R., a narrow gauge proposed to run to White Oak mining district north.

It is stated that enterprise in the town (El Paso) is slow, as it is entirely in the hands of Mexicans, foreigners being unable to *own* property within a belt of 60 miles from the border.

LITERATURE.

House Drainage and Sanitary Plumbing, by WM. PAUL GERHARD, *Civil and Sanitary Engineer, Newport, R. I.* Reprinted from Fourth Annual Report of the State Board of Health of Rhode Island, 1882.

Mr. Gerhard has made a very complete and concise digest of the theory and practice of plumbing and drain laying. No composition could well be clearer, more explicit, or better illustrated, and it is no detraction to say that it is far above the level of the public understanding. It would require at least an amateur knowledge of house-drainage to follow the reasoning, and we can especially commend it to the amateurs as a safe corrective of much of the nonsense imbibed by that class of sanitarians. It would be a good idea for Mr. Gerhard, or the Rhode Island State Board of Health to publish a health tract made up of deductions from this pamphlet, without the arguments. The public desire to be told the right thing to do with very few words, and in an authoritative way; and this is just what health boards are afraid to do, for fear they will advertise or antagonize business interests. Wide publicity should be given to the statements about cowls or ventilators on pages 24 and 25, and one plumbing humbug exposed. Householders should know that they are unnecessary and useless on the tops of ventilating pipes, "the committee of the Sanitary Institute of Great Britain having found by a series of experiments that no exhaust cowl submitted to them for trial caused a more rapid current than prevails in an open pipe." In fact they are worse than useless, for in cold weather they frequently cause the closing of the pipe by ice, at the roof line, by the freezing of the moisture condensed by contact with the cowl. Another valuable point is made on page 52, where the public are advised against contract work in plumbing; and we have reason to believe that it is now quite common to have plumbing work done on commission. To expect good contract work in plumbing, in the light of experience, is simply preposterous. One reason for this state of affairs is that plumbing establishments are universally small and irresponsible concerns; but the best and chief reason for the existence of so much unsatisfactory plumbing work is not so much a lack of conscience on the part of the plumbers (although it may well be doubted if they have any), or of knowledge of correct sanitary theories (for they are pushed at them without end), as the fact that the materials provided for the trade are unsuitable for the purpose. In no vital feature of house construction is there such a lack of scientific, or rather common, sense adoption of proper mechanical expedients. The sanitary profession has been called into being to protect the world against the plumber; after a dozen years or so they have succeeded in muzzling him, so to speak; what ought to be done, and what progress is leading us to, is to abolish him and his pipes altogether. It is not creditable to the mechanical ability of sanitary engineers that they have not succeeded in constructing absolutely and permanently gas and water tight conduits from the water-closet to the sewer, and it is still less creditable to their enterprise that they have not considered the expediency of founding an entirely new system of materials.

That Mr. Gerhard himself has doubts of the ground he stands upon is suggested by a remark on page 39: "If we could have ideal sewers, house drains and soil pipes * * * * * * * * ;" and he is hardly to be blamed for the contradiction in the first paragraph of the pamphlet where he says: "It is the purpose of this paper * * * to establish rules * * * which, if carefully observed, will secure * * * work * * of a positively safe character." That is *positively* safe *if* the work is done perfectly, *if* the joints are all tight, *if* the building does not settle, *if* the floors do not shrink, *if* carpenters do not drive nails into lead pipes, *if* the iron soil pipe is not cracked, *if* it is not too thin, *if* it has been properly tested, and *if* the work is carefully watched, properly superintended, and inspected forever periodically, etc., etc.

Would it not be more creditable to the profession, not to say more satisfactory to the public, to construct the *ideal* sewer and house drain, instead of having all this bother and nightmare?

THE RENSSELAER POLYTECHEIC INSTITUTE.

At the recent annual meeting of the Alumni of this institution, the chairman of the Committee on Endowment announced that subscriptions had been received from graduates to the amount of $25,000. As the work is but fairly inaugurated, all were greatly encouraged by the success so far attained.

The *graduates* have undertaken to raise the sum of $100,000; but it is not proposed that the movement shall stop there; it contemplates, eventually, the establishment and endowment of new professorships, and the enlargement of the facilities for study, so as to cover the latest developments in practical science and engineering.

The Institute has always maintained the highest standard of requirements from its graduates; and as an acknowledgment of faithful work in the past her sons now propose to aid her to maintain the enviable position she has held so long among the technical schools of the country.

OBITUARY.

CHARLTON B. KID was born in Philadelphia in the year 1836, and died in this city on the morning of Sunday, May 28 last, at the age of 46 years.

Mr. Kid entered the Engineer Corps of the United States Navy May 21, 1857, as Third Assistant, and in July of the same year he was ordered to duty on the United States steamer Merrimac. Mr. Albert Stimus, who distinguished himself in building, and in operating the iron-clad Monitor in the engagament with the Merrimac at Fortress Monroe, was Mr. Kid's chief engineer on his first cruise in the navy, and always spoke of him in the highest terms. In August, 1859, he was promoted to the position of Second Assistant, and in February of the following year was detached from the Merrimac, ordered to the United States steamer Niagara in April, and was attached to her while employed in laying the first telegraph cable between Europe and America. He was highly complimented by his chief engineer for many suggestions regarding the arrangement of the telegraph machinery. In February, 1862, he was examined and promoted to first assistant engineer, and during the same month ordered to the Rhode Island. This vessel was employed to supply others engaged in blockade duty, and was constantly in service, the voyage extending from New York to Galveston. To the ability and untiring energy of Mr. Kid was due the successful duty performed by the vessel. In June, 1862, he was ordered to the Powhatan, but Congress having appropriated a large sum of money to enable the Navy Department to experiment with various kinds of machinery, Mr. Sherwood, the Chief of the Bureau of steam engineering, selected Mr. Kid as the best qualified person to conduct these trials. At the time Messrs. Dickerson and Sherwood were disputing as to the value of expansion of steam and the type of valve gear to be employed, a board of eminent engineers was organized, and machinery erected on the grounds of the Novelty Iron Works of this City. Mr. Kid arranged all the apparatus and organized the plan of conducting the experiments. The calculations and deductions were all made by him and have since been published and largely copied in engineering works. In December, 1867, Mr. Kid resigned from the navy. During his service he earned the reputation of being a man devoted to his duty and profession, singularly modest in his nature, very gentle in his judgment of others, a thoughtful student of much culture and sound reasoning. In commercial life he stood very high for his faithful attention to engagements and his inherent honesty.

About eleven years ago Mr. Kid accepted the position of Superintendent of Section and Assistant Engineer Mechanical of the Dock Department of this city. He had charge of all the machinery in the department, and his long experience and thorough knowledge of the theory and practice of every branch of construction with which he was called into contact, rendered him extremely valuable to the service, while his courteous demeanor endeared him to his associates. At the first meeting of the Board of Docks after his death the following communication was received from the Engineer-in-Chief:

NEW YORK, May 31, 1882.

TO THE BOARD OF DOCKS:

GENTLEMEN: It is with very great regret that I have to report that Mr. Charlton B. Kid, Assistant Engineer and Superintendent of Section of this department died on the 28th inst.

I have been associated with Mr. Kid during all the time I have been in the service of this department (nearly seven years) and I wish to bear my testimony to his very faithful and valuable service during all that time.

Mr. Kid was a man of ability in his profession, of sterling integrity, devoted to his work, careful and correct in all he did, affable in manner and a general favorite with all who came in contact with him, and his long service in the department (nearly eleven years) had given him a familiarity with its affairs that it will be impossible to replace. His death is a severe loss, both personally and officially, to myself and all his associates.

Very respectfully, your obedient servant,
G. S. GREENE, JR., Engineer-in-Chief.

The following preamble and resolutions were unanimously adopted by the Board:

Whereas, The Engineer-in-Chief has this day reported the decease in this city, on the 28th instant, of Chariton B. Kid, Superintendent of Section and Assistant-Engineer Mechanical; and,

Whereas, The services performed by the late Chariton B. Kid, in the several positions which he has, from time to time, filled in the Department of Docks, have been of the highest order and exceedingly gratifying to the Board of Commissioners, and at all times in the interest and to the credit and welfare of the city; therefore, be it

Resolved, That the Board of Commissioners of Docks have learned with great regret of the decease of Charlton B. Kid, Superintendent of Section and Assistant-Engineer Mechanical, and take this method and opportunity of recording its high appreciation of the faithful services rendered the Department during the many years of his connection therewith.

Resolved, That this Board express its sincere sympathy with the family of the deceased at the irreparable loss they have sustained, and, as a mark of respect, attend the funeral services on the occasion thereof.

Resolved, That the foregoing preambles and resolutions be inserted in full in the minutes of this Board, and a copy thereof be transmitted to the family of the deceased.

PERSONAL.

C. S. DWIGHT has been re-elected Chief-Engineer of the Chester & Lenoir Railroad.

CADET ENGINEERS CHAS. G. TALCOTT, GEO. R. SALISBURY and **GEO. E. BARD** have been promoted to Assistant Engineers, from the 20th June.

M. RECLUS, chief engineer of the Panama Canal arrived in this city on Monday from Aspinwall, quite prostrated with one of the diseases of the isthmus. He is on his way to Europe.

ENGINEER CORPS PROMOTION.—The retirements of army officers, under the compulsory retirement clause, causes the following promotions in the Engineer Corps: Major O. M. POE, of Gen. SHERMAN's staff, and Major DAVID C. HOUSTON, to be lieutenant colonels; Captains WM. LUDLOW and WM. A. JONES to be majors.

COL. W. R. HYDE, a civil engineer formerly in the employ of the Central Pacific Company, died recently at Castor, Idaho. Of late years he had given his attention principally to mining. Col. Hyde was a member of the American Society of Civil Engineers, and a life-member of the California Academy of Sciences.

The copartnership heretofore existing between GEORGE C. BELL, S. J. FIELDS and JAMES S. METCALFE, under the firm name of the Niagara Bridge Works, of Buffalo, has been dissolved. GEORGE C. BELL purchasing the interest of Mr. METCALFE. The accounts of the late firm will be settled and the business continued under the same name by GEORGE C. BELL and S. J. FIELDS.

MR. ASHBEL WELCH, President of the American Society of Civil Engineers, and one of the oldest and most respected engineers in this country, has been appointed by the Governor of New Jersey a member of the commission which is to examine and report on the available water supplies of the State, and the best method for preserving and utilizing them, with especial reference to the supply of the cities of the State.

MR. W. R. GARRISON died at Long Branch, July 1, from injuries received in the railroad accident near that place a few days before. He was a son of Commodore C. K. GARRISON, and was, from early age, interested in his father's railroad plans and properties. He had been a director and President of the Missouri Pacific, director of the New York City & Northern, President of the Metropolitan Elevated and a director of the Manhattan Company. He was largely interested in the elevated roads in New York on his own account, having been connected with them almost from the beginning.

MR. NICHOLAS H. DECKER, an old and well-known contractor, committed suicide by throwing himself before a heavy wagon in Johnstown, N. Y., June 24. He had a stroke of paralysis a few months ago, which seriously affected his mind. Mr. DECKER had been engaged in many important works. His last contract was the extension of the third and fourth tracks of the New York Central from Rochester to Buffalo. He had many contracts on the New York Central, and had built parts of the Worcester & Nashua, the Providence & Worcester, the Lake Shore, the Staten Island, and other roads.

RECENT INVENTIONS.

NOVEL RAILROAD TIME SIGNAL.

This novel railway signal consists of a vertically moving signal slide carrying a pointer moving over an exposed scale. A rod is connected to and extends upwardly from the slide, and has a feed movement for drawing said slide upwardly. Combined with these devices is an electro-magnet and generator, an armature with an automatic make and brake, a contact-maker or circuit between the battery or generator and magnet, and a tripping device connected to the feed movement, whereby a passing train will cause the signal to be dropped, closing the circuit on the magnet, thereby causing the armature to be vibrated, the feed move- to be actuated, the slide to be raised and the time since the train passed to be indicated.

RAILROAD CROSS-TIE.

This improved tie is made of iron in one piece and is composed of a flat horizontal base-plate cut out in its middle portion and a vertical web extending the entire length of the base and terminating at the ends, with boxes adapted to receive wooden blocks, on which are secured the rails by bolts passing through the box and wooden block.

NEW METHOD OF PROPELLING VESSELS.

This construction embodies a reservoir and pipes on board a steamship, the pipes being run fore and aft and provided at their ends with branch pipes, and then approaching each other, so that currents of steam and water escaping from said branch pipes will impinge upon each other, to give motion to the boat.

PILE FOR USE IN THE CONSTRUCTION OF WHARVES, ETC.

This novel pile consists of a hollow central metal, and wood end sections, the lower one of the latter having an orifice connecting with the chamber in the metal section. Ferrules on the end of the metal section receive the ends of the wooden sections, which are secured by bolts having split heads to receive brace-rods.

YIELDING AND BUOYANT PILE BREAK-WATER.

Another similar invention by the same party comprises a break-water constructed from single piles hinged to a water-bed anchorage and grouped together in sections, each section being connected to the next by chains, and each pile of a group connected to its adjacent one by a link near its top.

NEW PROCESS OF UTILIZING EXHAUST STEAM.

This process of utilizing exhaust steam consists in forcing the exhaust steam of an engine into a tank of water of high temperature by a jet of live steam, then forcing the steam into a superheater from said tank to be revivified, and there mixed with a jet of air from a pump; then passing it into the steam receiver, when it is in condition to be conveyed to the engine.

APPARATUS FOR SUPPLYING STEAM IN CITIES.

This invention consists of a steam generator, with a high and lower pressure steam-main, combined with a pipe conveying steam from the high pressure main to an engine, a pipe to convey exhaust steam from the engine to the lower pressure main, and a pipe to convey exhaust steam from the exhaust main to the place of use.

WASHINGTON, D. C. F. B. BROCK.

CORRESPONDENCE.

THE METRIC SYSTEM.

BOSTON, July 1, 1882.

EDITOR ENGINEERING NEWS:

The International Committee of Weights and Measures, at its session of Oct. 2, 1879, unanimously adopted the following resolutions:

1. "The International Committee of Weights and Measures adopts, for its publication and its official use, the following system of abbreviative signs for the metric weights and measures."

2. "The International Committee charges its Bureau to bring, by circulars, this system of abbreviative signs of the metric weights and measures to the knowledge of the Governments of the High Powers contracting(for the support of the International Bureau of Weights and Measures),and to recommend them to favor,by appropriate measure,its general introduction in their respective countries." (*Procès-verbaux des séances de* 1876, *page* 42.)

This system of abbreviations, which therefore has an international significance, was printed in ENGINEERING NEWS of April 8, 1882.

Just one year subsequently, at the session of Oct. 2, 1880, the International Committee of Weights and Measures unanimously adopted resolutions vigorously defining the *liter* for scientific purposes, and adding two new denominations, with their abbreviations, for expressing the minute quantities of volume and weight frequently required in scientific work.

The resolution defining the *liter* is as follows:

"The International Committee of Weights and Measures adopts, for its publications and for its official use, the word *liter* to express the volume of one kilogram of pure water at its maximum density. The thousandth part of a liter, that is to say, the volume of one gram of pure water at its maximum density, will be designated by the word *milliliter*, and by the sign *ml*. The thousandth part of the milliliter, namely, the volume of a milligram of pure water at its maximum density, will be designated by the word *microliter*, and its sign will be the letter λ." (*Procès-verbaux des séances de* 1880, *page* 30.)

The use of the liter in this sense was thus explained:

"All volumes determined by hydro static weighings will consequently be expressed in *liters*, instead of of *cubic decimeters*, in *milliliters*, instead of *cubic centimeters*, and in *microliters*, instead of *cubic millimeters*." (*Idem, page* 29.)

The adoption of the turn *microliter* and its symbol λ to designate the thousandth part of the *milliliter* is in conformity with the practice previously adopted in respect to the *meter*, by which the word *micron* and its symbol μ are used to represent the thousandth part of the *millimeter*.

The symmetry of this notation was completed by another resolution, which announces, "the word *microgram* and the use of its symbol γ, to indicate the thousandth part of the *milligram*." (*Idem, page* 56.) C. H. SWAN.

RAILROAD ECONOMICS.*

BY S. W. ROBINSON, C. E., OF THE OHIO STATE UNIVERSITY, MEMBER OF THE BOARD OF INSPECTORS UNDER THE HON. H. SABINE, COMMISSIONER OF RAILROADS AND TELEGRAPHS.

IRON BRIDGES.

The prevailing form of iron bridge is the Pratt truss for long spans, and for short the plate girder. The change from one form to the other occurs usually at lengths between 60 and 100 feet. These statements apply more definitely to recent practice than former. The older iron bridges are very promiscuous, both as regards form and manner of putting together. Some of the first iron bridges in the State were Howe trusses, one of which went down in the Ashtabula disaster. But in place of the latter we now find what is probably the strongest iron Pratt truss in the State, so that people need not now go around Ashtabula to avoid a second catastrophe.

The parts of truss bridges were formerly united in various ways, sometimes by bolts, notches, and locks, and often by riveting in place. But at present the method by pins and eyes prevails, especially for the longer trusses. In upper chords, however, though the tie rods are usually attached by pins, yet for increasing the rigidity they are made continuous by riveting on splice pieces extending past the pin-holes. The forms of parts of bridges, as well as the methods of joining, are almost as though stereotyped. Thus the "eye-bar" is an article of manufacture, and is used in all parts of bridges except upper chords and struts or columns.

Upper chords and end posts are most frequently made of two channel bars, 12 to 18 inches apart, with webs vertical. They are joined on top by a longitudinal plate extending the whole length and rivited to the flanges, while the bottom side is latticed or "laced." "Web" members serving as struts are most frequently composed of two channel bars at a distance apart, and connected by diagonal lattice slats riveted on. Sometimes, however, the two channel bars are rivited by their webs to the flanges of an I-beam. Formerly Phœnix, Keystone, box, and other columns, nearly or quite closed, were much in use, but they appear to have given place almost entirely to such open columns as above mentioned, simply from the necessity experience has developed of painting every inch of surface in iron bridges.

Most engineers require forms such that a paint brush can touch every part, either inside or out. The advantage of this is seen from the fact above mentioned of the rusting of truss rods and of tin roofs from moisture and smoke. The statement also, which has come to my notice, that tons of rust have been removed from tubular bridges, is in point.

Floor-beams, made by riveting four angle-bars upon the edge of a plate,—two upon each edge at opposite sides,—are the most common. The section approaches that of the I-beam. Plates are often riveted on top and bottom, part of the length, to increase the strength at the middle part where the moment of strain is greatest. These beams are most frequently suspended from the pins of the trusses by inverted "∩" bolts. But when there is scant room below a bridge, for water-way or otherwise, they are in some cases rivited to the vertical struts.

The stringers are most frequently of rolled I-beams.

The lateral stiffening is much better attended to in iron bridges than in wooden ones. The lateral ties not only vary in size, from end to middle, but differ in size according to span, width, etc. There is generally a lateral system at both the bottom and top chords.

Plate girders are usually formed by riveting angle bars to the sides of the webs, top and bottom, then across these a flange. The latter is increased by additional "lifts" laid on in the middle portion. These plate girders are usually of uniform depth, though some have been met in which the upper flange or chord was arched so as to nearly join the lower chord at the ends. Vertical stays of angle-bars are riveted to the web throughout these girders, but nearest together at the ends; their object being to prevent the buckling of the webs. Most usually the two girders of a bridge are joined by riveting to the floor-beams, so that all forms a connected system. An angle-plate then is set between the floor-beams and girders, to prevent the latter from swaying or careening.

But on some roads many of the plate girders have wooden floor-beams; the latter sometimes resting directly upon the lower flanges and sometimes on angle-bars rivited to the girders. A neat and serviceable small bridge, where there is sufficient water-way, consists of plate girders, about 10 feet apart, with lateral and sway bracings, and upon which are mounted the wooden floor-beams. This plan is carried down to I-beam girders of 10 feet span or less.

In a few instances weak iron bridges have been strengthened by springing iron arched ribs from the abutments, composed of channel iron, and securing the same to the trusses at a suitable number of points.

At the present day many good iron bridges are found to be too weak. This is due not to any engineering defect, but to the growth in weight of freight loads and rolling stock. We now find 60-ton locomotives where formerly there were 40; and 20-ton loads per car where there were 10. Hence bridges designed to a strain of 10,000 pounds per square inch of iron section, as due to the former loads, must now stand 15,000, or perhaps more. This is unfortunate since an iron bridge is so difficult to strengthen in a satisfactory manner, and so difficult for the road-men to get renewed.

Expansion and contraction of iron bridges is provided for in supporting one end on rollers. In short spans, however, rollers are dispensed with, and the bearing plates slide. Often the observed expansion reported by bridge attendants does not account for the whole variation of length, even where rollers are in use. It is believed by some that the rolling resistance under so much weight is so great as to spring the piers where piers are tall. Thus it appears that strains, due to constrained expansion, may be too great upon chords to be ignored in calculating total strains.

STRAINS UNDER MAXIMUM LOADS.

In proportioning the parts of bridges for resisting their strains, a great variety of detail exists in the present practice. We find no "live" bridge engineer of to-day adopting a fixed maximum load per foot for all spans, even for the same road and the same trains; neither do we find the same fractional part of the ultimate or elastic resistance of the iron adopted for the allowable strain for all parts of any one bridge. The factor of safety is "a thing that was" to such an engineer.

In the first place the quality of the iron is allowed to differ for different parts of bridges. Tension members are never made of anything but "double refined" iron, that is, iron that has been double rolled. This consists of taking "muck bars" (the result of first rolling from puddle blooms), cutting and piling them, reheating to a welding heat, rolling into bars, then cutting, piling, and reheating again, when they are rolled to the needed sizes. Compression pieces are single refined, in which the last piling and rolling above described is omitted. Channel bars of columns and upper chords are thus treated.

A fair quality of double refined iron in bars should have a tensile strength of 50,000 pounds per square inch; an elastic limit of 26,000 to 30.000 pounds per square inch; should stretch 15 per cent. in 8 inches; bend 180° around a cylinder of diameter equal its thickness without fracture; and when kicked and broken should show a fibrous structure. Such iron in the regular truss tension members is usually allowed to be strained to 10,000 pounds per square inch for the maximum load. In some cases floor-beams are allowed 8.000 pounds only, because they are strained nearly to the maximum allowed for each passage of load. This is true of floor-beams, because the greatest load occurs when under the drivers of the locomotive. In the main truss, however, the maximum strains are only reached when the whole train is to the maximum, a condition which does not happen with every train. The ∩ shaped hangers for floor-beams are usually allowed only 5.000 to 7,000 pounds. Struts and upper chords are computed as columns, and on a supposed basis about 8.000* pounds square inch. This low value is probably partly due to the fact of single rolling for channel iron.

ASSUMED MAXIMUM LOAD.

In calculating the maximum strains there are two ways of treating the question of the maximum load. 1st. By adopting the greatest actual train weights, such as two of the heaviest locomotives, followed by a train of the heaviest loaded freight cars; then computing the strains as static effects to which results are added, for "dynamic effect," about 25 per cent. for spans of about 20 feet, 15 per cent. for spans of about 50 feet, 10 per cent. for spans of about 75 feet, and diminishing to no per cent. at spans of 100 feet and over. 2d. By assuming fictitious train weights which are uniform per foot for the span, but which are much the greatest for short spans. Thus, for some roads on this plan, the assumed load for calculating strains is 6,000 lbs. per foot for 10-feet spans, 4,000 for 40-feet spans, 3,000 for 150-feet spans and 2,500 for 300-feet spans.

This diminishing scale is to be accounted for as providing, first, for impact: the latter being greatest for short spans, because so much more quickly passed by the forward end of a train, and causing an application of load which is so sudden as to be of the nature of a blow; and, second, because short spans have the locomotive itself for the maximum load, while longer spans can only be covered by adding to the one or two locomotives some portion of the train.

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*Extract from a paper read at the annual meeting of 1881 of the American Society of Mechanical Engineers.

* By a rational formula for columns, published by the writer since this paper was presented to the Society, it is shown that this value should be but a little over 6,000 pounds, See Van Nostrand's Eng. Mag. for June, 1882.

CRYSTALLIZATION OF IRON IN BRIDGES.

As regards the deterioration of iron in use by crystallizing, there are differences of opinion and too few facts. One man will present evidence of crystallization, while another will produce equally good evidence against it. It appears that data are too uncertain. When rods taken from a bridge are found to be crystalline, it is not known whether they were not so when put in. But this matter will be settled in due time, because positive data now exist as to the condition of iron in existing bridges. When the future engineer shall examine the parts of these bridges, and compare notes with the former records, we shall know how about crystallization.

STEEL BRIDGES.

We are now at the verge of a steel bridge era, several important steel bridges being already built and in process of construction. The more serious mechanical difficulty in this direction is already overcome in the existence of machinery for the manufacture of solid steel eye-bars. Steel is in every way better fitted for bridges than iron. It is less subject to deterioration, becoming more uniform in results of manufacture, has an ultimate strength of nearly double that of iron, and an elastic limit from two to three times as high. Considering the strength, it is but little, if any, more costly. This step from iron to steel is but the natural course from cast-iron up, which latter material is now entirely abandoned as a material for bridges, except for unimportant members, such as wall plates, packing pieces, etc.

SWAY BRACING.

In both wood and iron bridges "sway" bracing is universally employed in deck bridges. But such bracing is held in doubt by some, except at the ends of the bridge, where it should be especially strong. The reason given for this belief is that where one truss receives a greater strain than the other from any such cause as wind against the train, train at one side, as in double-track bridges, curved track, etc., each truss should be allowed to remain in a plane. But the sway braces preserve the cross-section, so that if one truss deflects more than the other, each truss must careen to one side to some certain corresponding extent at the mid-span, but not at the ends; because here the solid abutments prevent. This forces the chords laterally out of a straight line, causing horizontal transverse strains upon them. The eye-bars on one side of the lower chord would, under these circumstances, be strained more than those on the other side, an inequality which would disappear in the absence of sway bracing. Not only would the main trusses be effected, but the lateral bracing at top and bottom would be strained unduly, and probably higher than provided for in the oversight of this matter. The old Ashtabula bridge was an iron deck, and who can say to what extent the sway bracing was responsible in the failure of it?

Though the one consideration of greater flexibility of cross-section seems to favor the omission of sway braces, in that we thus obtain freedom from stresses in one system of bracing as due those in another system, yet it is probable that the yielding cross-section will allow the train, while under wind pressure, to be forced to a greater inclination toward the leeward, thus causing a probable greater displacement of the center of gravity of train toward the leeward truss, and increasing the strain on the latter.

VIBRATIONS AND STRAINS.

In observing the deportment of a bridge as a swift train passes over, the parts are seen to be much agitated. Tie rods will often fly about at the middle parts to a very considerable extent. This has evidently received some attention by engineers, because in a few instances tie rods at the crossing points have been found tied together apparently to stop vibrations. That all such vibratory movements cause direct strains in the vibrating parts there can be no doubt; and it is unfortunate that these vibrations cannot be predetermined so that the strains resulting from them can be calculated. Could these be accurately determined, it is probable that the practical maximum working stress for bridge iron in tension could be safety raised from 10,000 pounds per square inch to 15,000 pounds; a margin being still left between the latter figure and that for the elastic limit for indeterminate strains due to such movements as considered below.

LURCHING OF THE BRIDGE.

In some cases the whole central part of the bridge is also in an agitated condition, both vertically and horizontally. There seem to be various causes for this, such as want of perfect balance in the drive wheels and connections, error in perfect alignment of rails, especially in the vertical plane, wandering of the wheels from side to side over the 1 to 1½ inches of clearance between flanges and rails, irregularity of curves on bridges, tangent points on bridges, etc. In some cases this seems to amount to an oscillatory or vibratory movement of the whole bridge.

A BRIDGE INDICATOR.

In order to study these effects more satisfactorily, as well as the "dynamic effect" of a moving train upon a bridge, an instrument has been devised which might be called a *bridge indicator*, the object of which is to give a graphic record of the movements of a bridge as a train passes it.

TESTING AND SELECTING MATERIAL.

In the selection of material for bridges, great care is exercised by bridge companies, much greater, indeed, than is usually supposed by the mass of people who ride over their bridges. Some bridge companies make tests of the materials not specified or required by the railway companies ordering. For instance, the Detroit Bridge Company examines all the eyebars for a bridge by piling a quantity of them and passing the pin through the eyes at opposite ends simultaneously. Any bar preventing the passage of the pin is thrown out. Then the bars are individually tested to a tensile strain of 15,000 pounds per square inch, and again the pins must similarly pass. If any eyebar has stretched so as to prevent the passage of the pin it is rejected. Such a practice would discover hidden flaws, and would pay if discovering such flaws only at the rate of one in a hundred bridges. A flaw which would probably have been made known by such a test was actually discovered by the road master of the Baltimore & Ohio Railway in one of his iron bridges, and the piece had to be removed. A first-class catastrophe might have here resulted except for the keen eye of the road master. There are those who object to straining iron going into a structure, especially beyond the working load. But a test which will discover the few hidden flaws that would otherwise pass unobserved, will probably more than offset imaginary evils due to strains which, though within safe limits, are somewhat in excess of the adopted working load. Accordingly this test is believed to be a most excellent one, but of the few bridge companies conferred with in regard to it by the writer, it has been found in use only in the one instance named.

All companies do more or less testing with testing-machines, including pieces ranging from small "test specimens" to full-sized bridge members. Tests for tensile resistance are by far more plentiful than compressive, but a good number of the latter are on record including full-sized bridge-columns. It is a quite common practice, however, to test a piece taken from a large bar rather than the whole bar itself. Large bars are thus found to have a lower tensile strength than smaller rolled bars.

Testing-machine tests for tension, to meet the present demands of bridge builders and companies, must make known at least three quantities: 1st, the elastic limit; 2d, the ultimate strength: and, 3d, the percentage of total elongation of some specified portion of the original bar, usually 8 inches. In some cases the greatest reduction of section is noted, and by some this item is preferred to the percentage as above.

As regards the elastic limit, it is found not to be perfect, that is to say, some permanent elongation is alway experienced by good iron before arriving at what is usually adopted for that limit. But practically these elongations are nearly proportional to the increments of load, and extend nearly through the whole range of loading up to the so-called elastic limit. Beyond this limit, however, they rapidly increase. The point where this change takes place is noted as the elastic limit. This limit, thus found, is given a more rational showing from the fact that, if at any point within it, the strain be relieved and then restored, no further permanent elongation is experienced till after passing the previous condition of strain. At points beyond the elastic limit, however, this is not the case. An extended examination of iron specimens will verify the following facts: 1. Bars immediately from the rolls, which have not been subjected to jars or other causes of strain, will experience permanent elongation at very slight tension. This is true also of bars direct from the annealing oven, even though they had previously been subjected to violent mechanical action. In these cases there appears to be no limit of perfect elasticity. 2. A gradually applied and removed tension within the usually accepted elastic limit produces a permanent elongation, which will not be increased for like or less tensions as above stated. This is also true of compression. 3. A specimen which has been strained, as indicated in 2, will take a permanent set for a slight reversal of the strain. 4. At the point where the permanent elongations cease to be nearly proportional to the increments of load, or to the elastic elongations, we find the usually accepted elastic limit. Some of these facts can be verified by simply straining a piece of annealed wire by hand.

But the most common tests in use among bridge builders, and which are at once both invaluable and fortunately of easy application by any blacksmith, consist, 1st, of bending a bar 180° around a cylinder whose diameter equals the thickness of the bar, and which the bar must stand without fracture to be accepted; 2d, of nicking a bar on one side with a cold chisel, and bending it similarly as in 1st with the nick at the bow of the bend, when it will usually break, showing a fracture which must be fibrous and free from glistening points or faces. Very frequent use is made of these tests in the smithy workshops where waste pieces of bar ends, which have no other value except for scrap, are put to a most valuable service.

HEADS OF EYE-BARS.

In the manufacture of one very important part of iron bridges, viz., the eye-bars, a number of methods are in use. One consists of forming the heads by a separate operation and then welding them upon the bars. The weld is made close to the head without upsetting the bar near the welding point. This must certainly reduce the sectional area of the bar at points so near the weld as to be heated but not worked, because the heat cannot be taken without corroding the iron, and thus eating away a small portion. But where full-sized bars of this kind have been tested to destruction, it appears that the rupturing point is always at some intermediate part of the bar considerably removed from the head, thus proving the reduction by burning to be unprejudicial. This practical ignoring of the slightly reduced end sections appears to be due to the influence of the head. This conclusion is verified by experiments in tension on extended necks of wrought iron, the fracture always occurring at some intermediate point in the neck.

In other cases heads are formed on the bars by welding several thicknesses of iron upon the side of the bar, thus giving a sufficient body of metal to form the eye. The reduction of section, above mentioned, by fire corrosion will take place here also, but actual experiment has shown it to be without objection for reasons above given.

SHRINKAGE IN RAILWAY VALUES.

The *Financial Chronicle*, in a late issue, illustrates the immense shrinkage in the market value of railroad stock during the past twelve months, by giving a table showing that 115 corporations have lost $514,000,000, if a comparison of the highest prices of 1881 is made with the present prices of the present year, 1882. The shrinkage of some of the stocks and their percentage of decline is given as follows:

	Shrinkage	
	Per cent.	Value.
Chicago, Burlington & Quincy	60	$34,209,507
New York Central	31⅛	28,058,128
Union Pacific	24¾	15,004,953
Northern Pacific	22¼	10,062,000
" " preferred	21⅜	9,044,000
Wabash	37½	10,290,000
" preferred	50⅝	12,380,000
Missouri, Kansas & Texas	27⅝	11,277,000
Denver & Rio Grande	61	17,797,000
Missouri Pacific	28	8,400,000
Central Pacific	17	10,076,000
Texas & Pacific	39¾	1[illegible],100,000
Oregon River and Navigation Co.	62	11,160,000
Erie	19⅝	15,100,000

An inspection of these shrinkages by investors who were so unlucky as to invest at the top of the market during the height of last year's speculative period ought to be enough to give them a fit of the blues, unless they sold out before the market declined largely.

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INSTANCES OF TIDAL WAVES IN THE GREAT LAKES.

The recent Cleveland tidal wave revives speculations as to the origin of these remarkable but not unprecedented lake phenomena. One theory is that they are caused by tornadoes which only touch the earth for a few miles and then bound off into the upper air, to return again, repeating this operation until their force is spent. The fact that a dark cloud, with wind, traveled with the wave when the latter was observed at Cleveland, would seem to show that the origin of this one is to be sought in atmospheric influence. The Claveland *Leader* gives the following *resumé* of similar phenomena in the past:—On Lake Superior, in 1789, opposite Isle Royal, there was a sudden fall of four feet in the waters. When they returned they did so with a rush, the vibration continuing for several hours. In 1884 the waters above the Sault Rapids suddenly receded, and in half an hour returned with great velocity. In August, 1845, Dr. Foster states that while in an open boat between Copper harbor and Eagle River, an enormous surge twenty feet in height and crested with foam, rolled toward the shore, succeeded by two or three swells. Dr. Foster observed repeated flows and reflows of the waters in 1847, 1848 and 1849 which preceded or followed storms on the lake. In 1851 D. D. Brockway reported, in a perfect calm, a sudden rise of one foot and three inches, and in another two and one-half feet. The Lake Superior *News* of July 17, 1855, reports extreme fluctuations between the hours of 9 in the morning and 4 in the evening. Father Andre, in 1670, while on Green bay, reported a three feet rise, but this was accompanied by a north-wester. On April 14, 1858, the Milwaukee *Sentinel* reported a change of level in Lake Michigan of six feet. May 10, 1823, according to DeWitt Clinton, at Otter creek, on the Canada shore, a wave came in nine feet in height, and the same occurrence took place at Kettle creek, twenty miles distant. Another in 1830 reports three waves at Madison dock, Lake county, O., the first rising fifteen or twenty feet. In 1844 or 1845 a wave came into Euclid creek, fifteen feet in height, carrying everything before it. On November 15, 1845, the water at Cleveland suddenly fell two and eight-tenths feet during a high wind from the south-west. The Toledo *Blade* records a change of ten feet on December 5, 1856. On June 1, 1872, at Charlotte, which is at the mouth of the Genesee river, the water rose twenty-two inches. In May, 1855, the waters of Seneca lake exhibited a like phenomenon of continued rise and fall of sixteen and a half inches to two feet through two days. Similar agitations of the waters have been observed in Lake Geneva in Switzerland.

THE OFFICE OF COUNTY SURVEYOR.*

BY FRED HOWELL.

We, of Ohio, have been the first to inaugurate an association of surveyors. Other States are following after us, and I believe these organizations will be the means of great professional improvement, and that they will ultimately raise the office of County Surveyor to the important position it was originally intended to occupy, and I hope that every member of this association will take a deep interest in making our meetings both interesting and instructive, so that the standard of our profession may be raised, and the people benefitted thereby.

There have been some arguments used against perpetuating the office of County Surveyor, owing to the fact that candidates are the choice of some political party, and no account taken of his qualifications. This, I am not only willing to acknowledge, but am anxious to have changed, and the remedy is simple.

Make no person eligible to the office of county surveyor who has not been a practicing surveyor for some years, or who has a diploma from some college, or who has not passed an examination before some competent board, to be appointed by the Governor, or other proper authority. Then let the nominee, who is the choice of the people hold the office.

We are thus willing that the competency of the county surveyor shall undergo a test, while at the same time the competency or ability of the other county officers is not called into question. Thus the importance of the office will be recognized.

The present laws gives the county surveyor considerable arbitrary power, and the people knowing that his work has more legal value than any other surveyors, makes it very necessary that he should be fully competent to perform his duties.

One of the difficulties the surveyor of the present day has to contend with is, not so much to make a correct survey, as to follow the lines of former surveyors, taken with incorrect instruments.

We need better instruments than are generally used. A surveyor, even if not the best in the world, can do tolerably good work if he has good instruments to work with; but I have seen some men try to run lines with instruments that I would defy the first professors of mathematics in the land to carry a straight line with.

Our laws provides that the office of county surveyor shall be supplied with stationery and all other suitable articles needful for the proper discharge of his office duties, and I have no doubt the intention of our lawmakers was to provide suitable instruments. Could we show our present legislators the ridiculousness of furnishing pens, pencils and paper to make elaborate calculations on, when the instruments used in obtaining the data for such calculations were altogether incorrect and unfit for use, I think they would soon amend the wording of the laws so that there could be no mistake as to their meaning, and that each county would be furnished a set of instruments of sufficient fineness of make to enable the County Surveyor to do practicably correct work.

Again, while the law makes the County Surveyor responsible for the correctness of his work, it says in effect that he shall not have the assistance of competent chainmen, one dollar a day being all the law allows them.

I claim that the surveyor's assistant or rear chainmen, should be as competent as the surveyor himself to carry the line and make correct measurements, and should be entitled to an adequate compensation.

I am satisfied we have the best sytem of public surveying that has yet been devised—the United States survey—but the perpetuating of that survey has been sadly neglected, and I am sorry to say some of this neglect stands charged against the County Surveyors themselves. But I believe the greater neglect has been by the people, and their representatives in our legislatures in not requiring that records should be kept of all surveys and plats, in the County Surveyor's office, thus giving a large amount of work to the incumbent of the office and making it remunerative, thereby inducing good men to strive for the position, instead of forcing them into other branches of business.

Not only should the field notes of the original surveys be kept in the office of the County Surveyor, but all subsequent surveys should be properly recorded in that office, with indices corresponding to the township and sections. The records should show for whom the work was done, at what time, and what new witnesses, if any, were taken. A record of this kind would be of the greatest importance to the people, as well as of great aid to the surveyor.

Now, if the County Surveyors have, in the past, neglected the business of keeping the records, for which I think they have sufficient excuse (no persons being very anxious to work unless they get paid for it), there is the greater reason why this state of things should cease to exist.

We must have all laws relating to the office overhauled and revised, have none but competent and honest men to fill the office, then get our legislators and people to uphold it by our showing them the difficulties of restoring lost corners, and the great amount of litigation likely to ensue from their loss, call their attention to the importance not only of preserving records of all landmarks in the office, and of the equal necessity of perpetuating the evidence of corners established by United States surveys by permanent monuments. The government marks were temporary, to last merely until the lands should be occupied, when, it was supposed, the owners would have interest enough to perpetuate them by durable monuments, instead of which the witness trees are being destroyed by the very parties whose interest should protect them. This destruction should be at once stopped.

Permanent monuments should be set at all corners of originally surveyed townships by the County Surveyor, and at the expense of the county. Indeed, all persons to whom I have spoken on the subject, seeing the difficulty of restoring those corners when lost, would be glad to have all section corners, as well, properly established and marked, and would be very willing to have the expense paid from the general tax duplicate. I would recommend that immediate steps be taken to have the laws so amended as to require every surveyor, on establishing corners, to put down something permanent that would show for itself that it was put there for a purpose, thus protecting it from removal or destruction. To further this end, the surveyor should be allowed, from the county treasury, a fair compensation for every monument so located by him.

A material very well suited for this purpose, and which could be furnished very cheap, would be vitrified pottery, similar to drain or sewer pipe, moulded in a rectangular form, with the proper letters and figures on the faces, representing township, range, and section.

All surveyors practicing within the county should be commissioned, qualified, and give bond the same as the County Surveyor, so that the people might have their choice of surveyors to do their work, and at the same time have the assurance that it was done by competent men; but all surveys should be returned to the office of County Surveyor for recording, and all surveys not so recorded should have no legal or official value.

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* Read at the third annual meeting of the Association of County Surveyors of Ohio, held at Columbus, in January last.

SANITARY AND RURAL IMPROVEMENT.

Delegates from the various sanitary and rural improvement societies will hold a conference at Warwick Woodlands, Greenwood Lake, New Jersey, on July 7, 8 and 10, for the purpose of forming a national association and for discussing various topics of moment and interest. Prominent among these topics will be "Water Supply and Sewerage Problems;" "Public Parks and Tree Planting;" "The Prevention of Nuisances;" "School Hygiene and Adornment;" "Sanitary Tracts;" "Women and Household Sanitation;" "The Electric Light in Towns and Villages," and "The Causes and Prevention of Malaria." Among those expected to attend and read essays are the Hon. Erastus Brooks and Dr. Elisha Harris, of the New York State Board of Health; Dr. John S. Billings, Vice-President National Board of Health, Washington; B. G. Northrup, Secretary Connecticut Board of Education; Dr. E. M. Hunt, Secretary New Jersey State Board of Health; Col. George E. Waring, Civil Engineer, of Newport, R. I.; Franklin B. Hough, Chief of the Forestry Division of the Department of Agriculture, Washington; Mrs. Isabella Beecher Hooker, of Hartford; A. M. Bell, M. D., editor of the *Sanitarian*; Prof. Henry Morton, President Stevens Institute, Hoboken; Frederick Law Olmstead, Brookline, Mass.; J. J. R. Croes, C. E., of New York; Rudolph Hering, C. E., of Philadelphia; Dr. D. F. Lincoln, Geneva, N. Y.; Dr. Joseph H. Raymond, Health Commissioner of Brooklyn; William Paul Gerhard, C. E., of Newport; Elwyn Waller, Ph. D., New York School of Mines; Dr. T. O'C. Sloane, Ph. D.; William Rupp, F. C. S.; Warren R. Briggs, Bridgeport; M. C. Heath, M. E., New York, and Col. John Y. Culyer, Brooklyn.

COMING SOCIAL SCIENCE MEETING.

Arrangements have been made by members of the American Social Science Association to hold their regular annual meeting at Saratoga, Sept. 4, the meeting to continue in session four days. The general sessions will be held in the evening, and department meetings in the morning. On the first evening an opening address will be made by the President, Prof. Francis Wayland, of Yale College, New Haven, Conn., and this will be followed by the annual report of the Secretary, F. B. Sanborn, of Concord, Mass. On Tuesday evening there will be addresses and reports from the Department of Education, and exercises will be observed in commemoration of the late Charles Robert Darwin, of England. On Wednesday evening the annual election of officers will take place, and an address will be delivered by Miss Clara Barton on "International Relief Associations." On Thursday evening addresses will be made by President Angell, of the Michigan University, on "The Relations between China and the United States," and by the Rev. Washington Gladden, of Springfield, Mass., on "Musical Forces." On Friday evening an address on "The Factory as an Element of Civilization," will be delivered by Carroll D. Wright, of the Massachusetts Bureau of Statistics of Labor. Papers will be read and discussed at the Department meetings in the morning. Among those announced are the following: "The School and College Curriculum of America and England," by Miss Helen Magill, P. D., of Swarthmore College, Penn.; "The Education of the Hand," by Mrs. L. E. Caswell, of Boston; "The Civilization of American Indians," by Miss Alice C. Fletcher, of Washington; "Boards of Health," by Walter Channing, of Boston; a paper on "Insanity—the Management of Chronic Inebriates and Insane Drunkards," by A. N. Blodgett, of Boston; "The Sanitary Condition of Boarding Schools," by D. F. Lincoln of Peekskill; "The Health of Criminal Women," by Eliza M. Mosher; "Professional Ethics," by Theodore Bacon, of Rochester; "Disfranchisement for Crime," by James F. Colby, of New Haven, Conn.; "The Penalties for Crime against Property," by Hamilton Andrews Hill, of Boston; "Local Self-Government in the Northwestern States," by Edward W. Bemis, of Johns Hopkins University; "The Modern Assessments of Co-operative Plan of Assessment," by George M. Sharp, of Baltimore, Md. Several reports will be made on factory and railroad labor.

FOR A COMMON PRIME MERIDIAN.

WASHINGTON, July 6.—Mr. Belmont, of New York, called up his motion in the House to-day for the reconsideration of the vote by which the House refused to order to a third reading the joint resolution authorizing the President to call an international conference to determine on and recommend for universal adoption a common prime meridian to be used in the reckoning of longitude and in the regulation of time throughout the world. The vote was reconsidered and the joint resolution read the third time and passed.

NOTES.

COST OF BUILDING A RAILROAD.

The Atlanta (Ga.) *Constitution* thus reports an interview with Major J. W. McCracken, who has charge of the building of the East Tennessee, Virginia & Georgia Company's new line from Macon to Rome:

"To start with, how long is your road?"

"It is 161 miles long with 12 miles of side-tracks—total 173 miles.

"How much did it cost to survey the line and locate it?"

"Colonel Sample and I rode over the line from May 30 to June 4. The engineer corps were filed up by July 26. We paid out to these corps just $65,000 before we had decided on our exact route."

"The route once decided on you had to buy the right of way. How much did that cost?"

"Just $85,000. Of course much of it was given to us, but we paid to agents and for the right of way $85,000."

"You had to have equipments, tents and tools and wagons and machinery to work with—cost of this."

"About $175,000. You see we bought the very best of machines for laying track, for building trestles, grading, etc. These are very costly. Our equipment was first-class in every respect. And much of what we have can be resold."

"Then having secured the right of way you had to go to grading. How much did that cost?"

"The grading alone cost $850,000. But we have already paid out to contractors for grading, bridges, etc., $1,500,000. The Rome extension is not finished and we will pay out nearly enough to make the total paid to contractors go up to $2,000,000."

"Time for breath! Thank you. Track once graded the next is cross-ties—cost of these?"

"They cost us laid in the track $460,000. There are 2,640 ties to the mile or 456,720 ties between Rome and Macon. This represents the number of steps a tramp must take when he walks over our roads."

"After the cross-ties comes the rails. What did these cost?"

"The rails weigh 56 lbs. to the yard. They cost in New York, $858,350. To this must be added freight from Perth Amboy to Macon, Atlanta and Rome. Say in all $900,000."

"After the rails comes the depots. What about these?"

"We have paid out $216,000 for the ground for depots, yards, etc., the most of it in Atlanta and Macon. We have contracted for 20 depots at a cost of $75,000. They are to be tasty modern wooden depots. Of course our city depots will cost much more. We have not yet arranged definitely for these."

"How about the equipment?"

"We shall use the splendid equipment of the rest of our line for this division, but to bring it up to the standard we have ordered for its quota to the general equipment 400 new coal cars, 600 box cars and 20 passenger cars, at a cost of $750,000, and 26 new engines at a cost of over $300,000."

That closes it up. Let's recapitulate; For tents, machinery, tools, etc., $175,000; for location and right of way, $150,000; for grading, bridges and trestles, $2,000,000; for cross-ties and laying them, $460,000; the rails, $900,000; depot grounds and depots, $291,000; and equipment, besides what the rest of the line contributes, $1,050,000, making a total of $4,926,000 for 173 miles. And that is what it costs to build a first-class road, as figured by one who paid out the money.

"Where was the most of this paid out?"

"In Georgia. The $2,000,000 for contractors was all paid out in Atlanta and most of it spent here. The $150,000 for survey and right of way was all paid out in Georgia. The $460,000 in cross-ties was paid along the Macon & Brunswick road for the Macon Division and along the track of the grade for the Rome Division. The $291,000 for the depots and grounds and most of the $175,000 for getting ready was spent here. Our bills for ten months with one house in Atlanta were over $75,000. We have spent about $3,000,000 for labor and material that circulated in Georgia."

New York Finances.

According to the monthly statement of the city debt, issued July 5 by Comptroller Campbell, the total funded debt on the last day of June was $126,041,807.59, not including $13,971,729.40 revenue bonds, issued in anticipation of taxes. The bonded debt of the annexed district above the Harlem River, which is included in this statement, is $975,500. On the last day of June the amount in the sinking fund for the redemption of the city debt was $38,384,989.21. During the month of June warrants amounting to $4,786,106.49 were drawn against the City Treasury, making a total of $22,844,258.88 since the beginning of the year. From Jan. 1 to June 30, inclusive, stocks and bonds were issued to the amount of $14,265,764.40. Of this sum, $958,500 was for public works, street openings and improvements; $465,000 was for Croton water purposes; $427,000 was for docks and slips; $160,000 was for expenses and awards of the Assessment Commission, and $12,154,100 was for current expenses of the city government.

Curious Patents.

The thousands of patents which are filed monthly in Washington form not one of the least important signs of the restless vigor and progress which the people of America are displaying in science and mechanics. But while many of these patents are of great practical value, there are great numbers which would appear to be visionary, though perhaps ingenious, to a practical man. The "cranks" are almost as numerous as the sound, practical men in making applications to the Patent Department in the capital. Not long ago an inventor, who is now in jail on a charge of fraud connected with the Peruvian claims, applied for papers of protection in connection with a chemical composition that would absorb as much caloric as might be required and retain it for twenty-four hours. By the means of this invention he saw his way to heat cars without any chance of danger from fire, or to allow every man to carry about his own foot-warmer in his pocket. A more ingenious gentleman has recently struck upon the idea of preserving beef and mutton while the animals to which these articles belong are actually in life. For instance, he will inject boric acid into the veins of a sheep. The natural circulation of the blood will carry the antiseptic through every part of the body, and when the unfortunate animal that thus innocently preserves its own flesh for future consumption comes under the care of the butcher, it will be found that the mutton will keep perfectly wholesome for a considerable period. An invention which has a more practical ring about it comes from Berlin in the shape of an iron chess-board fitted with magnetized pieces. In transatlantic traveling this singular chess-board will be appreciated by weary travelers if, as the inventor claims, the pieces will retain their position even if the ship heels over.

GENERAL INTELLIGENCE.

☞ We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.

GAS AND WATER.

Impure Water.—Toronto is in trouble in regard to the impurity of its water.

Yonkers Water-Works.—The report for 1881-82 is received. The Engineer and Superintendent, W. W. Wilson, states that the works were never in better order than at present. A new Worthington duplex pumping engine has been added during the past year, and the system of distribution has been increased to an aggregate of 23.4 miles of pipe. There are 250 hydrants, 154 gates and 496 meters. The daily consumption has been 840,000 gallons. The total rain-fall for the year has been 39.89 inches, of which the greatest, 6.78, was in June, 1881, and the least, 1.02, in September. The total receipts for the year were $22,562. The cost to pump, distribute and pay interest per 100 cu. ft. for the year was 13.30 cents.

Gas-Works at Newport, O.—Speaking of the City Council a local paper says: "This body will meet to-night, and, among other things that will come up for their consideration, is the gas question. It certainly is the observation of every intelligent person, that in towns and cities gas-works are always located near some river or stream, and at points least offensive and obnoxious to their inhabitants, and where the ground is of little value. One reason for this is to give facilities for dispensing of the refuse from all works of this kind. We have located in this city a coal gas-works without any facilities for disposing of its refuse in that portion of our city, which, in the near future, should become the most populous, and the ground the most valuable of any, and yet the owners of property and residents of that vicinity have allowed the erection of works the most offensive and noxious of any, without a thought of the future effect it will have on their property and homes. If any of the company or individuals than the proportion referred to had purchased the ground upon which it stands and proposed to erect coal gas-works thereon, these same property owners would have become alarmed and have entered a protest, and, perhaps, would have appealed, and properly, too, to the legal authorities for protection against the erection of what is bound to become an intolerable nuisance."

Water-Works Talked of.—The question of village water-works at West Rutland, Vt., is being agitated, water to be taken from the brook above A. J. Mead's residence.

Gas Works Purchased.—J. K. Graves, of Dubuque, has purchased the Iowa City gas-works, the consideration being $80,000.

Yorkville, Canada, Water Supply.—A late issue of the *Toronto Mail* states that the people of Yorkville are about to be compelled to face an unanticipated contingency in the shape of the exhaustion of their water supply. Nordheimer's creek, which has been the source of supply for many years, is fast dwindling into a mere rivulet, and the fear is felt in many quarters that but a short time must elapse before the creek will be *non est.* At the present time there is no water in the reservoir, and the supply has to be obtained direct from the engine. It cannot, in the natural order of things, last long, and the question now agitating the people is, Where are we going to get our water from? Annexation to Toronto is suggested as a remedy. Inquiries are being made in regard to artesian wells.

ELECTRICITY.

Richmond, Va., longs for the electric light, and the longing is in a fair way of being satisfied.

Electric Light in Washington, D. C.—F street is illuminated by electric lights of the Heisler Electric Light Company.

The Stillwater (Mich.) Electric Light Company is holding back to see how the experiment works in St. Paul.

Electric Light Company.—Articles of incorporation of the Racine (Wis.) Electric Light and Power Company were filed June 29. Capital stock, $16,000. They will furnish light for Racine and other cities if able to secure contracts.

Telegraph Wires in Europe.—In Paris the telegraph engineer lays his wires in lead pipes fastened to the tops of the arches of the drains. In Germany the exigencies of war and of climate led to the completion of the underground system of telegraph wires two years ago. In Vienna both telegraph and telephone lines are carried on brackets along the fronts of the houses.

Savannah, Columbus and Macon, Ga., have each a Brush Electric Light and Power Company. Capital, $100,000.

STREETS, DRAINAGE, ETC.

Cedar Blocks will be tried on two streets in Toronto.

St. Louis has let several contracts for street work.

Draining Lake Okeechobee.—The company engaged in draining Lake Okeechobee, in Southeastern Georgia, reports that the work is progressing satisfactorily. The dredge boats in use are fitted with all the modern appliances, and are the most complete of any ever introduced into the State. During the past five months as many miles of canal have been constructed, and it is expected that it will soon enter Lake Hichpochu, which is separated from Okeechobee by a strip of land of about three miles in width. The drainage of the lake is looked forward to with considerable interest on account of the almost universal supposition that there are vast beds of coal underlying its waters.

RIVERS AND HARBORS.

The Mississippi river has broken the Madison levee, eighteen miles above St. Louis, overflowing twenty thousand acres of farming land in Madison county, and floating away the stacked wheat.

Cincinnati, O., July 3.—Special dispatches from St. Joseph and Boonesville state that the Missouri river is very high and rising rapidly. At the former place it was 21 feet and rising, and at the latter 20 feet and rising, having risen 20 inches in a few hours yesterday afternoon.

Nothing for the Potomac Flats.—The Senate committee on Commerce has declined to agree to the proposition to incorporate the bill for the reclamation of the Potomac Flats in the river and harbor bill as a amendment.

Captain Eads' Plan Accepted.—The Mexican Government has accepted Captain Eads' plan for the improvement of Vera Cruz harbor, to cost $7,500,000.

Considering the River and Harbor Bill.—Washington, July 4.—The Committee on Commerce nearly finished to-day its consideration of the river and harbor bill. An amendment was adopted by a vote of six to two to increase the appropriation for the improvement of the Mississippi River, between Cairo and the head of the passes, to $5,000,000. This adds to the House bill the $1,000,000 asked for by the Mississippi Commission to close the gaps in the levees caused by the recent flood. $100,000 was also added to the House bill for the improvement of the Missouri River. Amendments were adopted appropriating $250,000 for the improvement of Beaufort harbor and of various rivers in North Carolina, and $100,000 for beginning the construction of the Hennepin Canal in Illinois. The amendments made by the Senate committee will add to the bill as it came from the House about $2,000,000, making the total to be appropriated more than $19,000,000. The committee hope to finish the bill to-morrow and report it to the Senate on or before Thursday.

RAILROADS.

A surveying party is now engaged in exploring a route for a line to connect the Virginia Midland Manassas Branch ending at Strasburg, Va., with Senator Davis's West Virginia Central & Pittsburg Railroad.

The progress in the North River Tunnel on the Jersey side for the last week has been 26 ft. The whole distance completed there is 1,172 ft. The crown-plates of the work on the New York end have been advanced in the same period 8 ft.

Northern Pacific Railway.—Meanwhile the North Pacific, under its new management, is more than fulfilling all its promises. Last winter was very mild and open. Work was scarcely interrupted. The end of the track is now 125 miles west of Glendive, the terminus of last season, the Big Horn tunnel and bridge are just completed and the road bed is ready for the rails 179 miles further. By the first of October, when the great bridge at Bismarck will be completed, the track will be laid to the eastern foot of the Bozeman range, where it is liable to remain till another season to await the completion of the tunnel at that point. It is only a little over 100 miles from Helena, and all the grading will be completed this season ready for the rails from the east. The tunnel through the main range near Helena is much further advanced than the Bozeman tunnel. The drills from the east end are in about 700 ft. already. The drilling is done by steam and lighting by electricity. Soon drilling will be in progress from the west and in the centre, so that there will be no delay here. We are as liable to see the cars from Portland, Or., first as those coming from the east. There is a large force of men at work at both ends and along the entire route, probably fully 10,000, and most of the work in modern railroad building is with horse-power. From the west the track is about to the western limit of Montana, and all the grade that remains to be built is in Montana. This will be nearly or quite completed this season and for the completion next year there will be only the track laying, with some tunneling and bridge building. If we have another as mild winter as the last, the track may be all laid by July, but it is not surely expected till September or October. As the investment crawls up above 50,000,000, there gets to be a powerful motive to hasten the completion. When the North Pacific reaches Helena, we shall be just 1,565 miles from Chicago, by way of St. Paul; about the same distance as Ogden, which is 450 miles south of here by the Utah Northern, nearer Chicago by at least 300 miles, than by the Oregon branch of the Union Pacific. On the west we shall be within about 800 miles of Portland, and 1,300 miles of San Francisco. Helena certainly is well situated to make a city as large as Denver. The sight of so much work going on about us and the promise of so much more has created something of a boom in real estate. Lands that a few weeks ago could have been bought for less than $10 per acre cannot now be had for $100. Three new banks have organized in Helena this spring under the national system. We wish we could add that a thousand new residences and buildings were going to be erected this season, but labor and building materials are too high to allow any such hope. Eastern mechanics are coming in, however, and doing better work at lower rates. There is a fine field here for master builders, contractors and material men with some capital and plenty of energy. Our old dealers cling to their accustomed high prices to the last, but their days are numbered and they must retire before those who will do more and better work on a narrower margin of profit.—*Correspondence Springfield Republican.*

C. H. Prescott has sold the Tawas & Bayles Railroad to General Alger, George P. Smith and others, who will extend it within thirty days to East Tawas, Mich., and also extend it up to the pineries by July 11.

London & Northwestern Railway.—A pretty big concern is the London & Northwestern Railway of England, with its 1,700 miles of line and principal termini at London, Liverpool, Holyhead and Carlisle, with connections to Edinburg and Glasgow. Its capital is about $500,000,000, and there are 40,000 persons employed to operate it. The management is in the hands of a board of thirty directors, who attend to details through various committees—and no member of the board is allowed to speculate in the stock. Every member is expected to give the most of his time to the road one week in each month. Many improvements have recently been introduced for the comfort and convenience of travelers, one of which is the checking of baggage so that it will be delivered to the owner's address at the destination.

Railway Progress in Texas.—At the close of work, July 2, on the Fort Worth & Denver City Railway, the end of the track was at a distance of 90 miles from Fort Worth. The business of the road is good, and continues to increase. Crops along the line are splendid.

The Ashland Railroad Company have filed articles with the Secretary of State of Wisconsin, the capital stock being $100,000, divided into 1,000 shares of $100 each. The road contemplated is to be constructed from a point of junction with the Chicago, St. Paul, Minneapolis & Omaha Railway, in the county of Bayfield, and will extend to and beyond the village of Ashland, in the county of Ashland. The length of the road will be about 10 miles. The directors for the first year are E. W. Winter, of St. Paul; W. H. Phipps, J. C. Spooner, C. W. Porter and D. B. Taylor, of Hudson.

The B. & O. R. R.—The Chief Engineer of the Burlington & Ohio Railroad Company has commenced locating the line of the road from Gillespie to Carlinville, Ill. A full corps of surveyors are in the field, and it is said that the work will be pushed to early completion. The following officers were elected at the meeting of the stockholders: W. C. Shirley, President; George P. Merrill, First Vice-President and General Manager; James Walker, Second Vice-President; M. McClure, Treasurer; L. C. Glessner, Secretary; W. F. Garis, Chief Engineer; R. Towner, Acting Auditor and Cashier; Robert Shirley, Solicitor. The first section of 10½ miles, from Carlinville and Gillespie, will be contracted for at once.

Railroads in Brazil.—The total extension of railways under traffic in the empire is 4027½ kilometers. Of this extension 1,103½ kilometers belong to the state, and 637 are operating under government guarantee. The total capital guaranteed by the state is 167,862,-572$173, or, excluding the Sao Paulo railway, 144,306,-722$173. Of this aggregate $16,000,000$ is guaranteed at 6 per cent., and the rest at 7 per cent.—*The Rio News.*

Construction in Michigan—East Tawas, Mich., July 3.—Surveyors are at work on the extension of the Tawas and Bay Company railroad from Tawas City to this place, and will probably assume the right of way granted to the Alpena Bay City railroad. The machine-shops and round house are to be moved from Tawas City to this place this week. It is reported that all mills here will shut down and men be put on the road to hurry it through.

The Atlantic & Pacific.—A note from Boston states that the following telegram was received by Col. H. C. Nutt, President or the Atlantic & Pacific Railroad company:

Albuquerque, July 1, 1882.—This day at 3:37 p. m. the first locomotive passed over the Canyon Diabolo bridge. One hundred and eighty miles of road-bed are ready for the track, and the contractors are pushing forward. Over two hundred miles of still rails are on hand and cross-ties to lay the great Colorado river. The track forces are ready, the material moving, and track-laying will commence at once. In a few days the track will be in reach of Prescott business, and the gold, silver, and copper mines, and pine forests at Arizona. There is considerable activity in the coal fields. Six mines are already opened and delivering coal. Everything is in readiness to go forward rapidly.

Lewis W. Clement,
Chief Engineer Atlantic & Pacific Railway.

A Narrow Gauge Scheme.—There is a rumor that a charter will be asked for a narrow-gauge railroad from Keene up the valley of the Ashuelot, through the towns of Surry, Gilsum and Marlow.

Successful Bond Negotiations.—A cable dispatch from Gen. Palmer, President of the Mexican National Railway Company, now in London, announces his successful negotiation of $10,000,000 bonds of that company, which will immediately complete the entire main line from Laredo to the City of Mexico. This is the largest American loan negotiated in London since Garfield was shot.

A New Hampshire N. G. Project.—There is talk at Keene of a narrow gauge road up the Ashuelot valley through Surry, Gilsum and Marlow.

A New Line of Road.—A note from Milwaukee dated the 29th ult. says: Day before yesterday contractors began grading at several points along a line of road from Red Wing to Northfield *via* Canon Falls, Minn. This new line, the survey of which was completed several weeks since, is intended by the Chicago, Milwaukee & St. Paul Railway Company to furnish a short connection between their river and Iowa and Minnesota divisions. The right of way has been mostly obtained, and the road will be pushed to completion this fall. The length of the line is thirty miles. When completed it will effect a saving of forty miles between the two divisions.

A New Wisconsin Railroad.—The Ashland Railroad Company has filed articles of incorporation; capital $100,000. The road will be ten miles in length, commencing at a point on the Omaha railway at section 10, range 47, in Bayfield County, running to Ashland, Wis. The construction of the road is likely to commence soon.

Buying Steel Rails.—The general manager of the St. Paul, Minneapolis & Manitoba Railway has purchased 3,500 tons of steel rails, for immediate use at various points on the line of the road.

Texas Surveys Completed.—The surveying and locating engineers of the Gulf, Colorado & Santa Fe Railway have completed their surveys of lines of the East Texas branch of the road to a point of junction with Bremond's Houston East & West Texas road. The junction is about 100 miles from the main line of the road.

The Eastern Division of the Canadian Pacific.—Toronto, June 28.—Mr. C. Hammond, Manager of the Sullivan & Marpoles section of the Canadian Pacific Railway, is here engaging men. This section extends from Algoma Mills 100 miles eastward, and there are now 750 men working on the first fifty miles. The country is very rocky and frequent blasting is required. At Algoma Mills the syndicate have constructed a large wharf. In the fall they intend to build an elevator and next summer a line of boats will run between that point and Chicago.

The New York, Texas & Mexican railroad has been completed to Victoria.

Menominee Valley Road.—Madison, Wis., July 3.—Amended articles of association of the Menominee River Railway Company were to-day filed with the Secretary of State. The amendment consists in an increase of capital stock from $665,000 to $1,500,000, with the privilege of extending the line from its present terminus at Crystal Falls, Marquette County, Michigan, in a northeasterly direction, through the counties of Marquette and Barga to Keweena Bay, a distance of sixty miles.

Pennsylvania R. R. Charters Granted.—Harrisburg, June 30.—Charters were issued to-day from the State Department to the following railroad companies: State Line, Brookland & Pine Creek Railroad Company, which proposes the construction of a narrow-gauge line, 20 miles long, in Potter County, with capital stock of $120,000; Goodrich H. Bush, of Westfield, Mass., president; Pike Mills & Kettle Creek Railroad Company, which proposes building a narrow-gauge railroad from Pike Mills, Potter county, to Westport, Clinton county, a distance of 40 miles; capital stock, $200,000; president, C. S. Bushnell, New Haven, Conn.; Sinnemahoning & Pine Creek Railroad Company, which is authorized by its charter to construct a narrow-gauge road 20 miles long, running along the west branch of Pine Creek to the source of the Sinnemahoning River, Potter County; capital stock, $200,000; president, Daniel D. Warren, Springfield, Mass.; Garfield & Cherry Grove Railroad Company which proposes the construction of a narrow-gauge road from a point on the Philadelphia & Erie Railroad, Warren county, between Sheffield and Tiona, to Garfield, a distance of 15 miles, capital stock, $200,000; president, Goodrich H. Bush, Westfield, Mass. This road is intended to accommodate the wants of the new Warren County oil field.

Extension Work.—Work on the extension of the Chicago, St. Paul & Minneapolis railroad in Wisconsin is progressing rapidly. The track is laid on the Superior branch to the St. Croix river. The work is to be prosecuted through to Superior City without interruption. This line, when completed, will be about 165 miles in length, from St. Paul to Superior City. On the Bayfield branch grading is in good progress, the ground being covered with graders. On the Chippewa Falls and Northern branch, from Bloomer north, the track is laid to Chetek, seventeen miles from Eau Claire. This line, when finished, will form the through route from Superior City to Eau Claire.

Duluth & Iron Range Railroad.—Engineer Case, with a party of eighteen surveyors, left the city for Agate Bay yesterday forenoon. They will establish a camp and base for supplies at the bay, in charge of Thomas Sexton. From this camp the party will draw its supplies for the work of surveying and locating the line, which will now be pushed as fast as possible from both ends. The whole line from Duluth to Vermilion will be permanently located and estimated for before November. Mr. G. C. Stone has been in the city several days, superintending operations in person. Engineer Lee and party are making good progress from Vermilion this way, and have secured a good line. Mr. Stone's advices from the man in charge at the mines are of the most flattering nature, and more men and supplies have been sent up from Duluth this week. Everything at the mines is going well. That there is iron enough there to justify the building of a railroad, Mr. Stone has not a doubt.—*Duluth Tribune.*

The W. & L. E. Extension.—Norwalk, Ohio, July 4. The track-layers on the Wheeling & Lake Erie Railroad have reached Toledo, and trains can now run to that city. The line between that city and here is mostly ballasted, and, in a short time, will be ready for regular operation. Track-laying is being vigorously pushed from Massillon toward Zoar, where connection is made with the Cleveland & Marietta, its last acquisition. Work on the shops here is progressing steadily. The foundations are mostly laid, and work on the superstructure will begin this week. The line in operation from Huron to Massillon is doing a large and increasing business.

CANALS

The Panama Canal.—Panama, June 24.—Much rain has fallen here, and canal and other work outside may be considered as practically suspended.

Paris, June 30.—The shareholders of the Panama Canal Company at the meeting held yesterday, approved the report of M. De Lesseps, and authorized the directors to issue obligations to the amount of £250,000 bearing five per cent. interest for the purchase of the Panama Railroad.

The Murray Canal.—The tenders received by the Railway Department for the construction of the Murray Canal are now being extended, and the action of the Government with respect thereto will be determined largely by the totals arrived at. It is stipulated that the foundation is to be ready by first of September, 1883; and the whole work is to be completed by the first of July, 1885. By the Engineer's measurement, the canal by the Presque Isle route will be six miles and a half long.

TUNNELS.

The Channel Tunnel.—London, July 1. In the action of the Attorney-General *vs.* The Submarine and Continental Company, the Chancery Division has granted leave to serve notice of motion for Wednesday asking for an injunction and inspection. The object is to prevent further boring for the channel tunnel. Since the government objected to the further prosecution of the work, Sir Edward Watkin has obtained leave to continue the work necessary for the safety of life, but prevented the government inspectors ascertaining whether that purpose was not exceeded.

CONTRACTS LET.

Contract for Granite Block Let.—The city of Minneapolis has made a contract for 500,000 granite blocks for paving Washington Avenue.

Sewer Contract Let in Lynn, Mass.—The Committee on Drainage has awarded the contract for building 600 feet of sewer in Essex street, north of Ireson street, to J. C. Bond at $1.25 per foot; and for building 200 feet of sewer in Warren street, to A. T. Thurston for 83 cents per foot.

CONTRACTS.

Among the eminently successful devices for rapid tracklaying on railroads that have come into use within a few years, that of Messrs. McLennan & Holman, of 94 Dearborn street, Chicago, is justly noted. Their "Patent Railway Tracklayer" is now in use on the following railroads, to the engineers of which interested parties are referred for information: Chicago & N. W. R. R., E. H. Johnson, Chief Engineer; New Orleans Pacific R. R., C. C. Barr, Division Engineer; Detroit, Butler & St. Louis R. R., Gen. J. S. Casement, Contractor; Kansas City, Springfield & Memphis R. R.; Flint & Pere Marquette R. R.; Saginaw, Tuscola & Huron R. R.; Wheeling & Lake Erie R. R.; Louisville & Nashville R. R.; Cincinnati Southern R. R. Mr. Holman spent the winter months in the South, where he had good success in introducing his machines.

BUILDINGS.

A New Hotel is soon to be built at Spirit Lake, Ia.

A New Hotel will be built at Cass City, Mich.

Should no new building enterprises be commenced in Minneapolis this year, there is enough work on hand to keep builders and labor well employed for the rest of the season.

Building Permits in Milwaukee.—The total amount of building permits issued by the board of public works in Milwaukee during last week was $25,525, against $42,720 for the week previous, a decided decrease. The price of brick has gone down perceptibly, but it was so late in the season, that not the same advantage will be taken of the fact as earlier in the season, before builders had so nearly completed their plans for the season.

Plans Filed in this City.—On the 5th plans were filed by Hon. Thos. L. James, Pres't of the Lincoln Safe Deposit Company, for the erection of a structure for the company on the south side of Forty-second street, about 150 feet west of Fourth avenue. The building will be fire-proof, seven stories high, have a frontage of 100 feet and a depth of 97 feet, be built of Belleville stone and brick, and cost $300,000. John B. Snook is the architect.

LABOR.

Striking Brickmakers.—Over 750 brickmakers in Denver have struck. The molders ask $3.50 per day, and the laborers $2.50.

BRIDGES.

A New Iron Bridge.—The Michigan Central Railroad company will soon build a new iron bridge across the St. Joseph (Mich.) river at Three Rivers. This bridge will have two spans of 120 feet each, and will cost from $12,000 to $14,000.

To Bridge the Arkansas and Mississippi.—The President has approved the acts authorizing the construction of a bridge across the Arkansas River at Van Buren, Ark., and a bridge over the Mississippi River at New Boston, Ill.

The Wrought Iron Bridge Company of Canton, Ohio, carry on works established in 1861. The present stock company was organized in 1870. About three acres of ground are occupied. The main building is 54 by 368 feet, one 100 by 150 feet, and another 50 by 150 feet. Sixteen forges are used, and one hundred and forty hands required in the works, and one hundred and forty employed at erecting bridges.

Bridge Unsafe.—The pier of the new iron bridge at Goodhue Mills, Cannon Falls, Minn., is giving away on account of the high water, and the bridge has been declared unsafe.

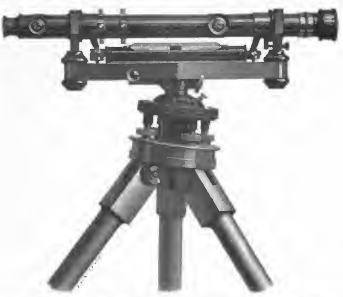
MISCELLANEOUS.

Judgment Against the Illinois & St. Louis Bridge Company.—A judgment for $285,128.95 in favor of Christian T. Christensen, and against the Illinois & St. Louis Bridge Co., was filed in the County Clerk's office, this city, on the 5th inst.

Patents.—The total number of patents issued on the 5th by the United States Patent Office was 419, of which 381 were new patents, 5 designs, 22 trade-marks, 5 labels, and 6 reissues of patents. During the fiscal year just ended there were 46,638 agricultural patents issued from the General Land Office. This is an increase over the issue of the previous year of 20,022 patents.

AN IMPROVED LEVEL.

A new Patent Y Level recently introduced by W. Gardam & Sons, manufacturers of surveying and engineering instruments, of New York city, possesses many features and improvements, which makes it a superior and stronger instrument in every respect. As will be seen from tha excellent engraving, tha most important improvement is in the quick levelling attachment, a device which enables the engineer to set up the instrument on uneven or hilly ground, and level it almost instantly, using the levelling screws for the finer adjustment, care having been taken to construct the levelling screws so that tha threads of the screw on the working portion are entirely protected from dust, dirt, etc., there being the least liability in this case of the screws cutting or abraiding from accumulations of grit.



To enable the reader to fully understand the details of the Quick Leveller, we have appended Fig. 2, which distinctly shows the form of socket B, on which the instrument revolves, and the manner in which it is attached to the parallel plates, &c., clamping ring A, ring C, spring catch E, tangent screw H, and clamp screw G.

In using the instrument proceed as follows: First screw the parallel plates to the tripod head, unscrew slightly the ring A, insert the socket B in the cavity provided for it, and bring the three flanges on socket B opposite the three openings in the ring C; then turn it in this position until the spring catch E drops over tha edge of one of the flanges on socket B, which prevents it from being turned backwards, and so takes away all liability of its falling out when being carried; now screw ring A, which causes it to grasp socket B firmly, and thus holds the instrument perfectly rigid, and it is ready for use.

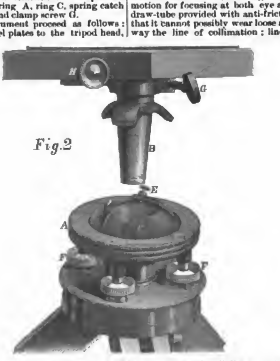


Fig.2

It is obvious that by slightly unscrewing ring A the instrument can be tilted in any angular direction at will; the amount of friction and bearing surface is so great that there is not tha slightest chance of the instrument shifting when being used. The simplicity of this device is so great that we will guarantee it cannot possibly get out of order with ordinary use and care.

The center of this instrument is made as long as possible, measuring over 3½ in., of large diameter and made of the finest composition of gun metal, possessing excellent anti-friction qualities, and is exceedingly strong.

The position of the tangent-screw and clamp is at the right hand of the observer at all times; the convenience of this arrangement is at once apparent to all those who have used the present style of level, in which the tangent is fixed to the lower part of the instrument, thereby necessitating the use of the right and left hands alternately, in effecting the necessary adjustments.

The telescope of this new Y level is long and powerful, magnifying over 32 diameters, extra large object-glass, giving an abundance of light, large and flat field of view, showing objects erect, rack motion for focusing at both eye and object ends, draw-tube provided with anti-friction bearings, so that it cannot possibly wear loose and affect in any way the line of collimation; line of collimation adjusted by us for all distances, telescope provided with an adjustable stop for bringing cross-wires truly vertical and horizontal.

In adjusting this level the shade tube is placed over the object glass, and the telescope focussed for a mean distance, so that it is in perfect balance each way from the center of the instrument; by our attention to this important point in adjusting the level, the greatest degree of accuracy is obtained.

Also the distance between the line of collimation and the point of revolution of the instrument on its center is decreased so that it measures only 3 inches.

The telescope is provided with a very accurately-ground spirit level, 8 in. long, to which a fine graduated scale is attached, care being taken to suspend it from the telescope, with solid castings of gun metal. Heretofore the suspenders have been usually made in two pieces, soldered together, and in case of a sudden jar they very often separate.

Careful attention has been given in designing this instrument, to use ribbed metal entirely, thereby reducing the weight, and at the same time strengthening those parts that are most liable to receiva severe strains; also, the material used is of the finest composition of bell metal, and it will be guaranteed free from defect; in fact, no pains have been spared to make this instrument perfect as far as possible.

Finally, the attention of the engineer is called to the fact that the Patent Quick Leveling device can be applied to any other instrument, whether level or transit, at a moderate cost. For further information apply to the sole patentees and manufacturers, W. Gardam & Sons, 96 John street, New York city.

OUR RAILROAD SYSTEM.

Advance sheets of the forthcoming volume of Poor's "Railroad Manual of the United States," have been issued. The year 1881 was one of extraordinary activity in railroad affairs. Within the year 9,358 miles of railroad were built. The greatest mileage for any previous year was 7,379 miles, in 1871. The cost, at $25,000 per mile, of the lines constructed during the year was $233,750,000. In addition, at least $75,000,000 were expended on lines in progress and $100,000,000 in improving their tracks, in building new stations, and in adding to their equipments. The total amount expended in construction during the past year was, in round numbers, $400,000,000. Up to the 1st of June, 1882, 3,677 miles of line were opened, against 1,784 for the same period in 1881. The same rate of increase will not be maintained for the remainder of the year, but the aggregate of new mileage is not likely to be much short of 10,000 miles. It is certain, says the Manual, that for a long time to come a much greater extent of mileage will be constructed annually than was constructed in the past or than will be constructed in the present year. Tha earnings of all the roads in operation the past year equaled $725,325,119, being an increase over the previous year of $110,000,000—the rate of increase being very nearly 18 per cent. The earnings equaled $13.60 per head of our population. Their net earnings were $276,654,119, an increase of $21,500,000 over those for 1880. Their current expenses were $449,565,071. The amount of interest paid during the year on their funded debts was $128,887,002; the amount paid in dividends was $93,344,200, against $77,115,411 for 1880. The cost of operating our railroads for the year was $449,565,071, or 62 per cent. of their gross earnings. The total amount expended in the construction of new lines and in operating and improving tha old ones was over $750,000,000—the greater part of this vast sum being paid in wages. The number of persons employed in operating them the past year averaged fully 12 to the mile of operated lina, or 1,200,000 in all. The number employed in the construction of our railroads equaled 400,000, increasing the total number of employés to 1,600,000, or about one thirty-second part of our population, estimated at 58,200,000. The tonnage transported on all the railroads in the country in 1881 cannot have been less than 3,500 tons to the mile, or 350,000,000 tons in the whole. The exact amount cannot be given from the want of returns from a large number of companies. The tonnage transported by the railroads making return to the Legislature of Pennsylvania in 1881, and having a mileage of 19,244 miles, equaled 132,410,802 tons; tha avarage being very nearly 7,000 tons to tha mile, the average for the whole country may be estimated at one-half tha average for that State. At an assumed value of $50 per ton, the value of the tonnage moved on all the railroads of the United States the past year, less one-third for duplication, was, say, $12,000,000,000, or more than $200 per head of our whole population.

Thirty years ago the tonnage of all the railroads in the United States did not equal one-half that of the Erie or New York Central Railroads at present, nor one-sixteenth that of the total now moved. The value of the tonnage of 1851, at $50 per ton, did not exceed $250,000,000, or only $10 per head of population, against a value $12,000,000,000, or more than $200 per head, in 1881. A number of carefully tabulated statements are given to show the good effects of railroads upon the agricultural development of the West in new States and Territories, as well as upon the imports and exports of the entire country. An increase of exports in 10 years is shown to the amount of $447,000,000, of which $330,000,000 is said to have been made up of tha products of the Western States, these being almost wholly due to the construction of railroads within them.

Endeavoring to show the "utter groundlessness" of the charges of monopoly made against railroad companies, statistics are given making comparisons between the freight rates of 1881 and those of 30 years ago. The New York Central and Hudson River Railroad's operations are quoted: "In 1855, immediately after its consolidation, this road moved 670,073 tons of freight at a charge of $3,758,320, and at a cost of $1.539,912, the net being $2.215,408. The tons moved one mile equalled 114,827.793; the charge was 3.270 cents; the cost, 1.341 cents; the net, 1.929 cents per ton per mile. In 1881 the same road moved 11,591,879 tons of freight at a charge of $20,786,750, and at a cost of $14 918,218, the net being $5.828,537. The number of tons moved one mile equalled 2,646,814,098; the charge was .780 cent; the cost, .562 cent; the net, .218 cent per ton per mile. The increase in tons moved on this road from 1855 to 1881 was 10,921,306, the rate of increase being in round numbers, 1,700 per cent. The increase in service performed —tons moved one mile—was 2,531,986,818 tons, the rate of increase equalling 2.200 per cent. The earnings from freight increased at the rate of 480 per cent., such rate equalling only one-fourth that of service performed. The cost of movement per ton per mile was only about one-third that for 1855, while the net per ton per mile equaled only about one-ninth that for 1855. Had the rates charged in 1881 equalled those of 1855, the gross earnings from freight the past year would have been $86,450,817 in the place of $20,786,749, the amount actually received. Had the same net rate been maintained, the total net for 1881 whould have been $52,875.086, in place of $5,828,537, the amount actually received. Charges have been reduced to rates that were believed to be impossible a few years ago. In 1872 it cost the New York Central 1.129 cents to move a ton of freight one mile. In 1881 it received only .788 cent for a similar service. In its reduction of charges the Central Railroad only represents the entire system of the country. The New York, Lake Erie and Western Railroad, in 1855 moved 842.055 tons of freight at a charge of 2 424 cents and at a cost of 1.155 cents per ton per mile. In 1881 it moved 11,086,823 tons at a charge of .805 cent. and at a cost of .529 cent per ton per mile. Had it charged as much per mile in 1881 as it did in 1855, its receipts from freight would have been $47,101.811, in place of $5,478,818, the amount actually received. The Pennsylvania Railroad moved, 1855, 865,006 tons of freight at a charge of 2.746 cents, and at a cost of 1.662 cents per ton per mile. In 1881 it moved 18,229.365 tons at a charge of .799 cent. and at a cost of .437 cent per ton per mile. Had it charged the same rates in 1881 that it did in 1855, its receipts for the past year would have been $73,195,832, in place of $10,801,089, the amount actually received. The charge in 1881 was .87 cent less than the cost of movement in 1872. The result of reduced charges is seen in the enormous increase of freight and of income—quantity making up for reduced rate of profits."—*N. Y. Times.*

ARE CANALS LONGER USEFUL?

The Hennepin Canal scheme has been suspended by the action of the Senate until a survey can be made and estimates of cost, capacity and various methods of management submitted. Of course, the project is not dead, but sleeping, and will be pushed in the near future with increased vigor. As the public will undoubtly be called upon to pay for this alleged improvement, it may not be amiss to inquire whether canals are not like last year's almanac—out of date.

Pennsylvania's canals, with but few exceptions, are only remembered in history, and nearly all the lateral canals in New York are being abandoned, while the Erie Canal, which was for many years the main artery of internal commerce for the Empire State, is only a burden and expense to the taxpayers. Of course, it is claimed, with some show of truth, that the canals of this State were gobbled up by the railroads and discontinued to enable them to rid themselves of a dangerous rival, but that if given a fair chance they could have maintained themselves in competition with the railroads. But late experiments, under the most favorable circumstances, have led to the conclusion that canals cannot compete with railroads in the carrying of freight, even in the matter of cheapness, much less in dispatch and promptness of delivery.

The Delaware & Hudson Canal, which extends from Honesdale, in Wayne county, to Rondout, on the Hudson river, and was built exclusively for the coal-carrying trade, has been one of the most profitable waterways of the kind in this country. It was the property of a private corporation, which run it on business principles, simply to make money. Its business has always been immense, being measured only by its capacity, and there is no prospect of a diminution of that business. But this company has been compelled by their increasing traffic to use railroads for their Western and Northern trade, and, as a result of actual experiments upon the relative cheapness of the two systems, have demonstrated that the railway is the cheapest and are now making the necessary surveys with a view to the filling up of their old canal bed and laying a railroad track in its place, which will be done probably within the next year.

This is a case in which the relative merits of the two systems have been subjected to the fairest kind of a business test and the canal found wanting. In the light of this experiment it seems the sheerest folly to advocate the building of any more ordinary canals as a means of compelling cheaper freights. If the government is to enter into the tranportation business with a view to regulating the price of freights in the public interests it had better build railroads.—*Philadelphia Times.*

TWO PRIMITIVE DRILLS.

Engineers who are in the habit of grumbling at the imperfections of even the best modern tools may perhaps feel interested in seeing the sort of apparatus in use amongst the workmen of barbarous and semi-civilized nations. Fig. 1 in the illustration subjoined represents a form of drill which is in very general use in the East, and which is, we believe, also employed in this country by the ingenious artisans who devote themselves to the riveting of broken china and glass articles. We have ourselves rarely seen it in actual use, but make the statement on the authority of Holtzapffel. It is known as the pump drill, and consists of a rod carrying a drill at its lower extremity. At the upper part is a cord passed through a hole, the two ends of the cord being held by a stick as shown. About the centre of the rod is a disc which serves as a flywheel. The cord, having been twisted round the rod, is caused to unroll by pulling down the cross stick, which sets the rod in rotation, which is continued by the action of the fly until the cord is again wound up, but this time in the contrary direction. The stick is again pulled down and the drill rotated as before. The tool from which our drawing was made is in the ethnological collection bequeathed by the late Henry Christy to the British Museum. It was obtained from one of the Andaman Islands. When the natives are unable to obtain a piece of steel they use a shell like that represented in Fig. 3. The total length is 2 ft. 7 in., the diameter of the fly being 4½ in.

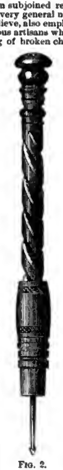


Fig. 2.

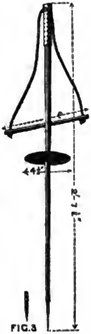


Fig. 1.

The specimen shown in Fig. 2 is of considerable interest and seems to show that the well-known Archimedian drill of the tool shops is after all of much earlier date than is usually supposed. Our engravings is prepared from a specimen now in the Indian collection at South Kensington, but we have been unable to obtain any information as to its origin. The material is hard wood of a dark color; the screw is treble-threaded, the pitch being 5 in., and the diameter $1\frac{3}{16}$ in. The total length is 1 ft. 8 in. The nut is not threaded, two pegs, the ends of which are shown dotted, serving to set the screw in rotation as the nut is worked up and down.

The authorities at the Indian Museum are unable to give any information as to the history of this interesting tool. They cannot say from what part of India it came, nor when it was added to the collection. We first saw it about seventeen years ago, when the museum occupied the upper story of the India Office at Whitehall, and ever since we have been in the habit of instancing it as a remarkable example of the inventiveness of the Hindoo. Further consideration of the matter has, however, led us to think that after all we may be mistaken, and we should be glad of the assistance of our indian readers to clear up the matter.

There is no doubt whatever that this specimen came from India and that it is of native workmanship. But it is not quite certain that it was not a copy of a drill which had found its way from Europe. The Archimedian drill was invented by a Mr. MacDowall, of Soho, who was rewarded by the Society of Arts in 1845. The earliest published description with which we are acquainted is contained in Haltzapffel's "Turning and Mechanical Manipulation," vol. iii. p. 1008.

If the specimen figured be a genuine Oriental tool, it is, like everything in the East, most probably of high antiquity, and is of great interest as showing the condition of the mechanical arts in our eastern empire. It will be noticed that the screw is left-handed, contrary to the usual direction of the threads of screws. That is considered by Professor Reuleaux as furnishing some evidence of antiquity ("Kinematics," p. 228).

But against this view we must point out that many of the drills which are found in the tool shops are fitted with screws of the same kind. We have made an extensive search in books of travel but have failed to find a description of this form of drill. It would be interesting to know whether it is known to be in use in any part of India or the adjacent countries.—*Engineering.*

TO THE EDITOR OF ENGINEERING.

SIR.—In reference to your valuable article on primitive drills, perhaps the few notes on the subject which follow may interest some of your readers. The earliest form of drill was a pointed stick twirled between the palms of the hands. This was improved upon by placing a socket at the top so that downward pressure could be applied, and using a cord wound round the stick once or twice for producing rotary motion. The cord drill, however, requires two persons to work it (unless the socket be held between the teeth, as done by the Esquimaux), and this difficulty was overcome by fastening the ends of the cord to a bow, which could be worked with one hand whilst the other held the socket. The last form of drill is almost exclusively used in Egypt, Persia, and India. The pump drill referred to in your article is an improvement on the bow drill in that the rotary motion and downward pressure can be produed simultaneously with one hand whilst the other holds the object in which the hole is to be bored. Perhaps it may be used by china menders for that reason, as the piece of crockery can thus be easily adjusted to such a positon as not to split. The pump drill is very largely employed in China, and is often of great size (up to 3ft. long). There are three varieties, viz., one with the cross-bar hanging loose against the drill, a second sort with a hole through the cross-bar so that it can slide up and down on the drill spindle, and a third kind where the flywheel is at the top of the spindle instead of half way down. There is a cast in the South Kingsington Museum from a mediæval sculpture, showing a carpenter using the pump drill. All the above forms of drills have been used for producing fire, and a very good account of this will be found in Tylor's Early Culture.

I am inclined to think that the Archimedian drill is really a modern invention, as it is not described in any of the standard books on travel; but perhaps some of your Indian correspondents might enlighten us on the point. The anthropological collections in the British Museum are so badly arranged and the catalogues so meagre that it is hopeless to try and find anything there even on the days when it is light enough to see the specimens. A really exhaustive collection of the primitive tools used by various nations well classified would be most instructive. I may mention in conclusion that the Pitt Rivers Collection at South Kensington is the only one where an attempt has been made at scientific classification.

I remain, etc., J. ROMILLY ALLEN.

5, Albert-terrace, Regent's Park, June 10, 1882.

THE CABLES TO CENTRAL AMERICA.—The cable steamers Retriever and Silvertown have landed the shore ends of the cables on the coasts of the Central America states, and will leave Tehuantepec on Thursday, laying the cable southward to Panama, thus completing telegraphic communication from Valparaiso northward. The officers, crew and cable staff are all in good health. The cables will be open to the public in August.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 229.)

CCCLIV.—WINCHESTER, MASS.

Winchester, Massachusetts, in lat. 42° 25′ N., long. 71° 10′ W., is on rolling ground.

It was incorporated as a town in 1850.

Water-works were built by the town in 1873 after plans of Walter H. Sears, C. E., taking the supply from a neighboring stream which was impounded by an earthern dam with stone masonry heart wall, 30 ft. high and 600 ft. long, forming a reservoir of 63 acres area and holding 260,000,000 gallons at 121 ft. above the town. Distribution is by wrought iron and cement pipe, of which there are in use 21 miles of from 12 to 4-in. diameter, with 76 fire hydrants, 81 gates and 589 taps. One meter is in use. The town contributes $15 per year for each hydrant. Service pipes are of rubber-coated iron, which does not give satisfaction; cement-lined wrought-iron pipe are to be used hereafter. The population in 1880 was 5,806. The daily consumption is not stated.

The works have cost $165,000. The bonded debt is $160,000 at 7 per cent. interest.

The cost of maintenance is not furnished. The receipts in 1881 were $9,457.40.

The works are managed by three water commissioners. W. T. Dotton is the Superintendent and Mial Cushman the Water Registrar.

CCCLV.—CAÑON CITY.

Cañon City, Colorado, in lat. 38° 40′ N., long. 105° 18′ W., is at the mouth of the grand cañon of the Arkansas River, in a park or valley, extending about 40 miles from the base of the mountains toward the north, south and east.

The town was settled in 1858 and incorporated in 1872.

Water-works were built by a private company in 1880, after plans of W. K. Johnson and under superintendence of Daniel Caird, taking the supply from a well or filter gallery, 25 by 75 ft. and 11 ft. deep, in the saturated gravel, near the river bank. The daily yield is about 500,000 gallons.

The water is pumped by a Knowles duplex engine of 1½ million gallons capacity, with a reservoir 35 by 100 ft. and 6 ft. deep, excavated in the limestone, on a ridge 150 ft. above the pumps and the city. In case of fire, the reservoir can be cut off and water pumped directly into the mains.

Distribution is by 5 miles of cast-iron pipe, of from 10 to 4-in. diameter, with 21 fire hydrants, 11 gates and 200 taps. The city pays $75 per year for each hydrant. Service-pipes are of galvanized iron.

The population in 1880 was 4,000. The daily consumption is 400,000 gallons.

The capital stock of the company is $50,000. The works have cost $75,000. There is a bonded debt of $20,000, at 8 per cent. interest. The expenses in 1881 were $2,000. The receipts are not given.

Orson G. Stanley is the Superintendent.

CCCLVI.—SEWICKLEY.

Sewickley, Pennsylvania, in lat. 40° 35′ N., long. 8° 10′ W., is on the Ohio River.

Water-works were built by the borough in 1874, after plans of Edeburn and Cooper, taking the supply from springs which have a water-shed of about one-third of a square mile. The water is conveyed from the springs, 875 ft., by a 15-in. earthenware pipe, to a reservoir holding 4,000,000 gallons, built in excavation and embankment, lined with puddled clay and brick pavement, and 100 ft. above the town.

Distribution is by 10 miles of cast-iron pipe of from 12 to 3 in. diameter, with 48 fire hydrants, 40 gates and 400 taps. Lead and galvanized iron service-pipes are used.

The population in 1880 was 2,054. The daily consumption is not given. The works have cost $75,000. The bonded debt is $60,000 at 8 per cent. and $14,000 at 6 per cent. interest. No further financial statements are furnished.

J. Boobyer, Jr., is the Secretary of the Water Commissioners, and John Patton the Superintendent.

[TO BE CONTINUED.]

The receipt of statistics as follows is acknowledged with thanks. From Orson G. Stanley, Esq., statistics of the water-works of Cañon City, Colorado. From Mial Cushman, water registrar, statistic and water rates of water-works of Winchester, Mass. From A. G. Moore, Superintendent, 42d report of Cincinnati, O., Water Department, for 1881. From J. Boobyer, Jr., Secretary, statistics of water works of Sewickley, Pa. From J. C. Willett, statistics of water-works of Frederick, Maryland.

* * *

THE NEW TELEGRAPH line of the Cherokee Railroad between Cedartown and Cartersville, Ga., is now in active operation.

CORRESPONDENCE.

CHIEF ENGINEER OF WATER-WORKS, ETC.

EDITOR ENGINEERING NEWS:

I have been asked to procure the names of the "Chief Engineers of Water-works" in some of the prominent cities of the United States, with the information as to whether they are "Mechanical," or Civil Engineers, and to which of the two classes do hydraulic engineers belong. I know of no better or more impartial channel through which to get the information required than through the medium of your paper (as an exterior source will only be credited), and respectfully request you to publish such data relative thereto as you may have at command, and without reference to the party making request and thereby oblige

Yours truly,

A. D.

[To comply with the above request involves no small amount of labor, the time for which we feel quite unable to give personally. We must refer our correspondent to "The History and Statistics of American Water-works" for the names of the chief engineers of water-works. As to whether they are "mechanical" or civil engineers, can only be learned by personal correspondence with each one. We think that "hydraulic" engineers may be, and necessarily must be, to some extent, "mechanical" engineers, but they are certainly included in the general term of "civil engineers," of which profession their specialty is one branch. —ED. ENG. NEWS.]

* * *

PANAMA CANAL SERVICE.

INTERNATIONAL R. R. CO., LAREDO, TEXAS,
Thursday, July 6, 1882.

EDITOR ENGINEERING NEWS:

Perhaps you would be good enough to inform me what the name and address of the Chief or Engineer in charge of the works at the Panama Canal is. Also if Junior Engineers or draughtsmen would be likely to get employment there. And oblige

Yours, very respectfully,

S. W. S.

[M. Reclus, the Chief Engineer, has recently gone to France. We do not know who is in charge during his absence. We do not know what the chances for employment in Panama are; probably they are good, as the death rate is high and the work must be kept in progress.—ED. ENG. NEWS.

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

At a meeting of the Society held on July 5, a paper by S. S. Haight, member Am. Soc. C. E., subject, "Accuracy of Measurement as Increased by Repetition," was read. The substance of this paper has already been published in ENGINEERING NEWS, pages 62 to 148, Vol. 8.

The following were elected to membership of the Society:

MEMBERS.

Peter C. Asserson, Civil Engineer, U. S. N., Norfolk, Va.; Edward Cook Burns, U. S. Assistant Engineer, Detroit, Mich.; David Dexter Clarke, Asst. Eng. Northern Pacific R. R., New Tacoma, Wash. Ter.; William Hooper Dennis, U. S. Coast and Geodetic Survey, Washington, D. C.; William Ludlow, Captain of Engineers, Bvt. Lt.-Col. U. S. A., Philadelphia, Pa.; M. William Mansfield, Engr. Maintenance of Road Cincinnati and Muskingum Valley R. R., Zanesville, O.; William Abbott Pratt, Engineer Ohio and Baltimore Short Line R. R., Connellsville, Pa.; Nathaniel Chapin Ray, Asst. Eng. Union Pacific Rwy., Sugar Loaf, Col.; Gen. William Starke Rosecrans, San Francisco, Cal.; William Harrison Smith, Res. Eng. New York, West Shore and Buffalo R. R., Oneida, N. Y. Junior, Frederic Nicolas Blanc, Civil Engineer, New York City.

A TEXAS CLOUDBURST.

A CORPS OF ENGINEERS CAUGHT NAPPING IN BUCK CREEK VALLEY.

Some ten or twelve days since Captain Merrill's corps of engineers and assistants were camped in the valley of Buck creek, in Childers county, Tex. Their tents were set 100 feet from the dry bed of the creek. This creek was about twelve feet deep from the level of the valley on either side of the bank. The valley is nearly a mile wide, but the high lands curved in close to the place where the camp was pitched, and the valley widened on the opposite bank. The night was clear, and no cloud in the distance betokened a rainfall. The boys staked their ponies near by, turned their mules loose, and laid them down to sleep in their tents. About midnight one of the boys felt water at his feet. Springing up he saw the water coming, and, yelling like a savage giving his war-whoop, roused his companions. In less than a minute they were standing in water up to their waists. Knowing to which side of them was the hill, they rushed wildly through the water and succeeded in gaining a safe foothold. The water rushed by them, covering the entire valley to a depth of six feet, and carrying away all the tents and baggage. The pony was saved by one of the boys cutting the stake rope as he passed him, he fortunately having gone to bed with his pants on. Most of the boys were in their night clothes, and a solemn set they were. The sudden rise of water was caused by what is known as a "cloudburst" on the head of the stream, some twenty or thirty miles away. Any number of cattle were carried down stream, but most of them finally escaped.—*Clay County Shield.*

* * *

TO WHOM HONOR IS DUE.

Mr. James R. De Remer, principal assistant engineer of the Denver & Rio Grande Railroad, has resigned his position, and is receiving much praise from the press and public. He deserves all the good words said of him, for he has been a faithful servant of the company and has done a work in which the entire traveling and commercial public is interested. Mr. De Remer is, by the way, one of a class of men who have not received sufficient encouragement at the hands of the public of the Rocky Mountain West—one of that little army of unassuming, independent and quiet civil engineers, who are seldom heard from and far more seldom seen, whose work speaks for itself, but speaks a language which is not always understood by those who reap the benefits, and not half appreciated by those who do understand it. Without the aid of the science which these men are able to bring to their assistance, the money of Warrishoefer and Vanderbilt and Gould would be of no avail in the building of railroads throughout the country. They are a necessity in the construction of all railway lines, however level and smooth the country. If needed in the work of laying out the roadways of prairies and plains, how much more are they an essential in the work to which they are called in the Rocky Mountains. Standing at the proper place in Denver on a clear day one can have a view of the great continental range from the Black Hills to the Spanish peaks. Between these two points the main portion of our trans-continental traffic is to be carried on. The principal public highways of the nation and of the world now run and are expected to be built across this barrier. What is the barrier? Nothing less than a solid pile of granite—a rock wall averaging no less than half a mile in height and at least 200 miles in width, if piled in compact form. Fortunately it is broken here and there by the force of the waters, which, in seeking their outlets to the seas below, have worn deep, rugged and torturous crevices into the stone. It is through these crevices that the railroads have expected to find their way—through defiles, which, in some cases, had never been trod by human foot until the bold forerunners of the iron horse marched in with rod and chain to find their own way and to mark out that for the millions of others to follow. So far no task has presented itself which has not been overcome. Picking their way with the caution of science they have not only succeeded in passing hitherto impregnable barriers, but have staked the way, have marked the ledges on which railroad tracks could be hung and outlined the curves and grades over which entire trains could pass. They have given us through lines on the north and south of us. In Colorado they have found a way over the Sangre de Cristo range, over Mosquito Pass, through Toltec gorge, through Grand, Clear Creek and Platte cañons, and two lines have been lifted over the perilous passes to the Gunnison. They have built a line on the very cliff sides from Black Hawk to Central. They are about to clamber over the mountain tops near Georgetown, and the deep defiles of the wild Indian country in the west, so deep and ugly as to have never been explored even by the agile aborigine, are rapidly making way for the approach of the railroad locomotive. It is safe to say that in the last five years seven hundred miles of railroad have been built in the mountains of Colorado, and almost every cañon has been explored to make places for other stretches of the iron ways. It is the civil engineers, such as De Remer, McMurtie, Blickensderfer, Evans, Robinson, Lowrie and Captain Berthoud, who have made this progress possible, shirking no hardship and courting no notoriety, content in doing the best they can for the accommodation of the world and adding their mite to the accomplishments of the exact sciences. They deserve more recognition than they have so far received.—*Denver Times, 5th.*

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, JULY 15, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.

COLORADO MEETING.

Programme.

Saturday, Aug 19—In Denver. A brief preliminary evening meeting, at which the Institute will be received by the citizens of Denver.

Monday, Aug. 21—Visit to Black Hawk and Central, with an evening session at Central City.

Tuesday, Aug. 22—Georgetown. Idaho Springs. Return to Denver in the evening.

Wednesday, Aug. 23—Leadville, going over the South Park Railroad. Evening session.

Thursday, Aug. 24—Excursions to the Leadville mines.

Friday, Aug. 25—Excursions to the Leadville smelting works, reaching Pueblo at night.

Saturday, Aug. 26—Pueblo Iron and Steel Works, and Mather & Geist's Smelting Works. Colorado Springs and Manitou in the evening.

Sunday, Aug. 27—Colorado Springs and Manitou.

Monday, Aug. 28—Return to Denver. Evening reception.

Tuesday, Aug. 29—Argo Smelting Works. Golden and its smelting works. Subscription dinner.

Besides these excursions, facilities will be afforded those who desire to see the iron and coal mines of Colorado. And for those who can extend their visit, an excursion to the San Juan district will be organized.

Arrangements are being made with the railroad companies for reduced rates to members of the Institute and ladies accompanying them. When concluded, a circular will be issued informing members of the expenses from different points to Denver and return. These rates will probably not exceed two-thirds the regular rates, or about $40, plus Pullman car special rates, from New York to Denver and return. Special facilities are courteously offered by the roads in Colorado for the excursions of the Institute.

Persons proposed for membership have the same privileges as members with regard to the meeting and excursions.

As usual at the meetings of the Institute, ladies are expected to be present. Seventy-seven members with forty-three ladies have already signified their intention of being present at the Colorado Meeting, and it is expected that the attendance will greatly exceed these numbers.

The unusual attractions offered by the mining regions of Colorado are increased at this time by those of the Denver Exposition of mining appliances, minerals, etc., and by the unusual facilities offered for examining mines and works, and acquiring information concerning them.

The representatives of several foreign kindred societies are expected to be present.

Members who purpose attending this most interesting meeting should at once write the secretary of the Institute, who has to notify the railroad companies of the number of tickets required, and the names of those entitled to the special rates offered. They are also requested to inform the secretary promptly of their intention to read papers at the meeting.

Prof. W. I. Marshall, who is well known by his lectures on the wonders of the Geyser Country, offers to conduct a party of not less than eight, nor more than twenty-five, through the Yellowstone National Park. This trip would occupy from twenty-six to twenty-nine days from Denver to and through the Park and back to Denver. The greater part of this time would be spent "camping out" in the Park. The expenses of this round trip are estimated at from $275 to $300 for each person. Full information concerning this trip may be obtained from Prof. W. I. Marshall, Fitchburg, Mass.

R. P. ROTHWELL, President,
27 Park Place, New York City.
T. M. DROWN, Secretary,
Easton, Penn.

THE RIVER AND HARBOR APPROPRIATION BILL.—The total amount appropriated by the House bill was $17,367,875. The Senate has now passed the bill after having increased it to $20,924,175.

THE *Annales des Ponts et Chaussées* for May contains an article on the Electric Light in Light-Houses, one on the Distribution of the Water in Irrigation Canals, and a Critique on Baker's paper, Actual Lateral Pressure of Earthwork.

IN sending postage stamps for Greene's Graphical Analyses of Bridge Trusses (of which we are selling about twenty-five a week) the *two-cent* stamps are most acceptable, since we have several months' supply of other denominations on hand, and these are of use in sending out our foreign mail, each paper having to be prepaid with a two-cent stamp.

THE Transactions for 1881 of the Society of Engineers is received. It is well bound and well printed, octavo volume of 208 pages, uncut; its contents are as follows: Inaugural Address of the President, Charles Horsley; Gas Engines, by Chas. Gaudon; Illumination by Means of Compressed Gas, by Perry F. Nursey; On Floating Docks, by John Standfield; The Prevention of Smoke, by A. C. Eugert; Vacation Visits; Iron Roofs, by Arthur T. Walmisley; On the Arrangement, Construction and Machinery of Breweries, by W. Barnes Kinsey. The volume is for sale at $5.00.

THE greatest naval display of modern times has just taken place in the roadstead of the historic city of Alexandria, Egypt. Emboldened by the apparent delay of the European powers, especially England, in protecting their interests, the vainglorious Arabi Bey defied them in the repair and occupation of the forts protecting the city, against the repeated warnings of the English Admiral. The terrific execution of the great guns from the war vessels in the bombardment of the 12th must have brought conviction to the minds of the Egyptians, while it illustrates the wonders of modern naval gunnery, and possibly suggests the danger that menaces our own rich and wholly unprotected sea-coast cities.

THE present military operations before Alexandria bring once more very prominently into view the wonders of the telegraph. Every movement is promptly cabled to America by the newspaper correspondents, and in New York the news is bulletined at every office several hours before it occurred. The telegraph ship Chiltern fills a prominent place in the action, and her every movement is duly chronicled. In fact, without the telegraph, the bombardment of Alexandria would not have occurred so soon, if at all, while to the outer world weeks must have elapsed before the news was communicated.

In answer to a correspondent, the N. Y. *Sun* gives the following brief history of the "Egyptian Question," which we reprint, since it cannot fail to be of interest to our readers:

"The present sovereign of Egypt, Mohammed Tewfik, is nominally the viceroy of the Sultan of Turkey, of whose dominions Egypt is theoretically a part. By various firmans or decrees he enjoys the privileges of an independent hereditary monarch, with the Persian-Arabic title of Khidiv-el-Misr, or King of Egypt, popularly rendered by "the Khedive." As such monarch he and his predecessors have contracted various public debts, a large portion of which are held by British and French subjects, and for the better securing their payment Tewfik placed, in 1879 and 1880, the management of the Egyptian finances in the hands of two Comptrollers-General, one appointed by Great Britain and one by France, virtually constituting them his administrative officers. Against this management Arabi Bey, representing the native political element of the country, rebelled, and the Khedive has been unable to subdue him. The present military proceedings have been taken by Great Britain, therefore, for the purpose of overthrowing Arabi and restoring the power to the Khedive—that is, to the English and French officials to whom he has intrusted it."

WE have more office room than we need, and offer to eligible tenants desk room or entire offices on the second floor of the Tribune building. We can sublet the two best offices in the building till May 1st next at low rates, and after that time can make satisfactory terms for tenants, as we have a three years option of our lease, and higher prices are sure to prevail another season. The rooms are new, well lighted, and in winter are heated by the lessor. They are the most eligible offices for engineers now obtainable in this city, and tenants have the full benefit of the home and foreign newspapers, books and periodicals coming into this office daily.

THE May number of the Journal of the Association of Engineering Societies has been received. Its leading paper is one by Dexter Brackett, Assistant City Engineer, Boston, Mass., entitled "Experiments Made with the Deacon Waste Water Meter System," read before the Boston Society on May 17th; it is illustrated with eight diagrams, and there are twelve pages devoted to the subject. Mr. Brackett has for many months been conducting a series of experiments with this meter for the City of Boston, and the results are given to the public in this paper. We have already described in this journal the Deacon meter and the method of using it. We therefore refer all those interested in the subject to this very complete article by Mr. Brackett. "Silt Movement by the Mississippi—Its Volume, Cause and Conditions," by Rob't. E. McMath, St. Louis, is an able paper on the hydraulics of the great river by one of its most enthusiastic observers; A. Mordecai, of Cleveland, has a paper entitled "Remarks on George Stephenson," and N. B. Wood of the same city contributes a paper on "Crystallization and its Effects Upon Iron." The price of the number is thirty cents, and can be had by addressing H. G. Prout, 12 Barclay St., New York City.

At Lebanon, O., on the 10th, the rain came down in such torrents about 4 P. M. as to completely fill, overflow and burst a large reservoir just above the town, covering 40 acres of ground, which was formed by an embankment some 30 ft. high. The people residing in the line of danger fled to the high ground and no lives were lost. The embankment began to crumble in two places which soon became one, when the whole flood of waters came pouring out of the reservoir. The first thing it met and lifted from its moorings was an immense iron bridge spanning the creek on the Dayton pike, a few hundred yards below the reservoir. This it landed over in an adjacent lot.

Next came the houses, fences, stables and bridges below. Nothing withstood its power, and the course of its track in half an hour was a sight of sad desolation. Five bridges, including a temporary railroad bridge, were swept away. Four houses were carried down with the current, together with the effects of the occupants, and are torn to pieces and scattered along the path of the flood. Some of the houses were moved but a short distance from their foundations, but were greatly damaged, while in all the dwellings in the section flooded the water poured through, driving their occupants out upon the adjacent high grounds.

Though no lives were lost, many narrow escapes were made. The town is in darkness, the gas tank having been washed away, and the homeless families are wandering about in the fields and sediment looking for their effects. The loss to the town will not fall short of $50,000, while many poor families have lost the fruits of a life of toil.

The loss to the county and to the farmers in the valley below can not at this time be estimated. The through trains on the Cincinnati Northern will not be able to run for several days yet.

THIS has been *the* hot week of the season, probably. The temperature for the corresponding week last year ranged about 77°, this week it has been over 90° for several days, resulting in doubling the death rate, and prostrating or enervating a large number of the people who have to remain in the city. On Wednesday, which was a little more endurable than Tuesday, the mercury at

8 p. m. registered 93°, at noon it was 85°, in the following cities it was as follows:

At noon in Albany the mercury marked 76°; in Bismarck, Dak., it marked 64°; in Boston, 89°; in Baltimore, 87°; in Buffalo, 76°; in Cleveland, 80°; in Cincinnati, 74°; in Louisville only 69°, a fall of 20° in twenty-four hours; in Philadelphia, 90°; in San Antonio, 98°, and in St. Louis, 80°.

In New York there were 187 deaths for the twenty-four hours ending noon on Wednesday, of which 95 were of children less than 5 years old. The wonder is that so many of the little creatures—poorly fed, hardly cared for, and confined to the miserable, squalid apartments of the tenement districts of the city—live through the terrible siege of a summer in this over-heated, baked city. It is estimated that over 350,000 New Yorkers have gone out of the city for the heated term, and every Saturday the railway and steamboat companies find their facilities quite inadequate for the tax upon them in conveying the crowds away to spend Sunday in the mountains or by the sea shore. New York is a mass of brick, stone and iron, upon which the hot sun pours its rays till everything is baked, and the reflected heat leaves hardly a cool spot to rest in. Rain dries up as it falls on the pavements and a few minutes after it ceases all signs of it are gone. The majority of business men, however, must remain in town, and were it out for the unequalled facilities for quickly getting out into the invigorating breezes of the bay or to numberless resorts not far from the city, summer in New York would be much more unendurable than it is.

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THE CINCINNATI, O., WATER-WORKS REPORT.

The report of the above Works for the year 1881, submitted by Supt. A. G. Moore, has just come to hand. The deficiencies of the pumping service are the most prominent features of the opening pages, and the superintendent italicizes the statement "that the Works, with their present limited capacity, cannot be depended upon to deliver the full supply during any future summer." This condition of things is due to the great increase in consumption of water, and the insufficiency in quantity and quality of the pumping machinery. There are not, as is usual in most well-equipped water-works, any reserves in machinery or boilers, so that what there is, is constantly in use. The actual available capacity of all the pumps is 32,000,000 gallons per day, while the maximum consumption is 38,000,000; if the highest daily consumption from both high and low services should occur in the same day there would be a deficiency of 7,500,000 gallons. The engines are not only of light construction and subject to expensive repairs and renewals, but possess defects otherwise, and are exceedingly extravagant with fuel, this item in 1881 being $69,000, of which nearly one-half could have been saved by the use of modern machinery. The principal engine is the Shield, which gives a duty less than 30,000,000 per 100 pounds of coal; the Scowden engines give about 45,000,000, the Harkness 43,000,000, and the old combination engines 46,000,000 pounds; these engines have been in use thirty-six, thirty-one, twenty-six, sixteen, and seven years, respectively; there are twenty-four boilers in seven batteries, which, like the engines, are deficient in capacity and without reserves. The superintendent gives an estimate for one engine, boiler, and boiler-house additions, *just sufficient to render the pumping plant adequate to present requirements.* Another engine of like capacity would need to be constructed in the following year. The engine recommended is of the compound condensing rotative type, with steam cylinders thirty nine inches, and eighty-two inches to drive two single acting plungers, each of forty inches diameter and thirteen feet stroke, and in connection therewith, one compound engine (33,000,000 gallons), dry well and foundations, and other items aggregating $1,349,500, the whole expenditure being over $3,000,000, which, when completed, will have a delivering capacity, including reserves, of only about 50,000,000 gallons per day, and if the construction of these should be entered upon at once, they could not be utilized before the summer of 1884.

The population of the Highlands has increased very rapidly; eighty per cent. of the seven miles of pipe laid in 1881 was in this service. The addition to the water mains in 1881 was one hundred and ninety per cent. over those of 1880. The situation now demands increased pumping machinery and boilers; increased supply lines and new tanks with greater altitude. The superintendent recommends a new, separate stand pipe system, connected with the Eden Park reservoir for the high service, the cost, as estimated, being $394,000, and the daily capacity being 8,000,000 gallons.

Estimates for a low service system are given; the capacity being 100,000,000 daily. The Scowden estimate for the proposed Markley Farm extension is $5,725,000; the Newport plan for pumping and conveying the water from the Kentucky side above the Little Miami River is $6,381,000. Four schemes are, therefore, proposed, and it is safe to presume that Cincinnati must, before very long, engage in the construction of an additional water supply.

The bill of costs, how to raise the money, and its comparison with that of other large cities forms an interesting chapter of the report. Water supply statistics for 1880 (from Engineering News), of twenty-three principal cities are given in tabular form; the total cash receipts in 1881 were $515,821; the disbursements were $513,080; the revenue for 1881 per one thousand gallons of water pumped was 5.55 cents and the cost was 3.7 cents, of which 2.52 cents was for maintenance and 1.18 for interest. The value of the entire Water-works on January 1, 1882, was $6,909,556; the value of free water is $45,900 annually.

There were 7.636 miles of new pipe laid, together with 161 valves, the cost being $83,642; the gallons of water per capita (264,000 people) was eighty seven; the average for low service was 6,056,420, and for middle service 19,476,739 gallons; the highest record was in August, the lowest in December. Thos. J. Bell's waste detector has been used with excellent results. The cost of pumping 1,000,000 gals. into Third street and Eden Park reservoirs was $18.04 of which $16.41 was for current pumping expense; deducting the expense of the high service the cost was $15.59 of which $14.40 was current pumping expense.

The subject of Smoke Prevention (illustrated), and of Contamination of River Water, from reports by Major Wm. E. Merrill, U. S. Engineer, accompanied by a map, and numerous other matters, mostly statistical, but all of interest to Water-works superintendents and companies, are treated in this able report which occupies eighty-one pages octavo, and which can probably be had by addressing Supt. Moore, Cincinnati. The labor of preparing such a document is very great and it is but very poorly appreciated. It is well for the general welfare of all large city communities that there are faithful and competent men in charge of departments like Water-works, else a sad day of reckoning for willful waste, reckless extravagance and neglect, and criminal carelessness would visit many a city without sufficient warning to be of use.

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AMERICAN CONTRACTING IN BRAZIL.

It may perhaps interest readers of Engineering News to hear of American pluck and enterprise in successful competition with other nationalities for the construction of public works in Brazil.

The Ponte dos Remedios (Bridge of Remedios) completed a few months since, is the first and only structure of the kind ever built on the river Amazon or its tributaries; the nearest point where they have iron bridges is Ceara, many miles south on the coast.

The bridge is a Pratt Truss, one span, 125 feet clear, full width 40 feet, roadway 20 feet wide, two sidewalks, each 8 feet clear. The lower chord is of wrought bars, upper chord of channel bars. Height of truss 20 ft.; flooring about 3 ft. above lower chord. The roadway floor stringers are I iron, sidewalk, stringers wood. The roadway is floored with "Itauba" planks, 4 inches thick, 6 to 8 in. wide and 19 ft. 8 in. long. The sidewalks are floored with "Massarandnba" planks 2 in. thick. Both these native woods are very hard and durable, "Itauba" resembles American teak. The flooring of the bridge alone cost the contractors $3,000. The iron work was all in place within 6 weeks after its arrival in the port of Manaos, and was erected under disadvantages from unskilled labor, but happily without the least accident. Four ornamental iron lamp posts, each having three lights, the globes having the arms of Brazil cut on them, furnish light by the "Gas globe" system. The bridge was built to sustain a moving load of 2700 lbs. per lineal foot. It spans an "Igarape" or arm of the river dividing two portions of the city of Manaos. The bridge takes its name from the eastern portion, called "Remedios."

The contract for the bridge was made by the Province of Amazonas with Mr. E. Backus, until recently United States Consul at Para, during the administration of the President Seur, Dr. Satyro d'Oliviera Dias, and was concluded during the administration of the President Dr. José Alarico Furtado. The design was made by C. B. Brisbin, C. E., of Lewistown, Pa., who left this country in January, 1878, as one of the engineers in the Collins Expedition to Brazil, to build a railroad on the Madeira River, and who, notwithstanding the trials and hardships of that ill-fated expedition, all the members of which, with the exception of himself, have long since returned home, has remained in the country and made for himself a name and a fame. Mr. Walter B. Bassett, of Indianapolis, Ind., was Superintendent of Construction, and went to Brazil especially for the work. The Chief Engineer for the Province is Dr. Joaquim Lacovigildo de Sanza Coelho, a gentleman of very great learning and ability. The Assistant Engineer for the Government, on the bridge, was Dr. Gregorio Tharmaturgo de Azevedo, a young military engineer of ability. The Brazilian engineers treated the American contractors with great courtesy.

Messrs. Backus and Brisbin have contracted for a Market House to be built at Manaos. The superstructure will be all of iron. The building will be very high and capable of being thrown open, the sides being composed of iron venetians. The flooring to be of blue stone. The ground plan will be 40 meters front by 41.55 meters deep. The building is to be highly ornamental, surmounted by a large eight day clock, and altogether will be one of the finest of the kind in Brazil. All material will be taken out complete from this country and England, as well as the workmen for its erection. The contract was made by the President, Dr. Jose Alarico Turtardo.

Manaos, the capital of the Province of Amazonas, Brazil, a city of 6,000 inhabitants, is situated on the Rio Negro, about 8 miles from its conjunction with the Solimoes or Amazons. It is the principal city on the Amazons above Para, and is a great center for "borracha" (rubber) "Brazil nuts," "piassuba," "cumurn," oils, dies, hides, etc. At present there is a direct line of steamers to Europe, making five trips a year, and a direct line to New York making three trips a year, both subsidized by the Province. The trade is large and increasing rapidly and Manaos is destined to become an important center for the trade of the interior of Brazil and the adjoining countries.

C. H.

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POLLUTED SCHUYLKILL WATER.

Philadelphia is having something of a scare this week over the prospect of having to contend with a volume of polluted water which in its course down the Schuylkill must soon reach the pumping station of their water-works at Fairmount. At Reading and Pottstown the fish were dying in considerable numbers from the effects of the water, and the water-works authorities at other points lower down were watching with a good deal of interest for the signs of pollution or poisoning. Superintendent Slingluff of the Norristown Water-works thinks there is no occasion for a scare, and he ascribes the whole trouble to "an increase in the pumpings from old coal mines, and a decrease in the amount of limestone water, its natural neutralizer." The pumpage from the Pennsylvania coal mines all contain more or less diluted sulphuric acid. The superintendent says:

> Just above Reading two fine limestone streams used to empty into the Schuylkill. Last year the Reading people, in order to have a pure water supply, stopped one of these streams from flowing into the river and used it as a reservoir. Perhaps if this had not been done there would still be enough limestone in the river to neutralize the acid. But canal men report that the acid discharges have been increased by the emptying of an old mine belonging to Church & Co., which has not been pumped for twenty years. Now the fish, not being able to get the proper amount of oxygen through their gills, are suffocated and may be seen all along the river about Pottstown, I am told, coming to the surface and gasping in their efforts to get air. They breathe the sulphuric acid gas and are killed. Between here and Pottstown, however, there are a number of limestone streams which flow into the river and must have a neutralizing influence if the acid continues to come down. But a little sulphuric acid is not very dangerous. It exists in very minute quantities in most waters and is an important ingredient in most medicines. As human beings do not breathe through their gills they would not be affected in the same way as the fish.
>
> I have no reason to believe that we will experience any difficulty here at Norristown, but even if we do, I think Philadelphia will escape, for from here to Conshohocken, a distance of three miles, the limestone strata again crosses the river and forms its bed and the water has to flow over it. I think it may be safely assumed that there will be nothing in the river coming down from above which will make the water you get at Philadelphia any worse than it is already."

Meantime the Philadelphia officials and medical men are considerably exercised, and an expert has already been sent up the river to make every exertion to obtain a satisfactory solution of the difficulty. A number of theories have been advanced, of course, and it is hoped that the impurities will be so dissipated and neutralized before reaching Philadelphia that no bad consequences will ensue. One result of the scare will be to draw attention anew to the steady and increasing pollution of Philadelphia drinking water by the discharge of foul substances along the Schuylkill, and there may possibly be enough influence brought to bear to diminish the evil for a time at least.

THE AMERICAN WATER-WORKS ASSOCIATION.

The report of the second annual meeting of the above Association, held at Columbus, O., March 14, 15, and 16 last, is just received. In a preliminary note, the Secretary, J. H. Decker, states that owing to the crude and almost useless state of the stenographer's copy of the minutes of the meeting, he has been obliged to rely very largely on his memory for his report, a circumstance to be deplored somewhat, as the proceedings of this and similar associations are beginning to embody so large and valuable a collection of facts and experiences of actual work that they ought to be given as complete as possible.

The report consists of an octavo pamphlet of sixty pages, and is illustrated with several large diagrams relating to the subjects treated, and which cannot be represented here. Among the subjects discussed, that on "Pressure Systems" was the first. It was given in the form of a report from Mr. T. J. Whitman, chairman of the committee on the subject, and was as follows:

PRESSURE SYSTEMS.

The word "pressure," applied to water-works, is usually intended to mean the pressure in the distribution pipes tending to burst them, and is usually expressed in pounds per square inch, or in feet in height of a column of still water whose weight on a square inch of base is the pressure in pounds avoirdupois per square inch.

The head of supply may be produced either by actually taking the water from a level higher than the distribution, or by forcing it into the distribution by pumps driven by external power.

At any given point in a system of distribution pipes, the pressure must either be constant or variable. The former only occurs either when no outlet is open, and there is a constant head of supply, or in the case of a steady flow where an equal quantity of water passes out of any outlet in equal times, and there is a constant head of supply. In this case the pressure is always less than when no outlets are open.

Practically, there are only two classes in which pressure can be considered. Those cases in which the head of supply is nearly constant, and those in which the head of supply may be varied at will, as the real pressure at any point is always varied by the flow at the neighboring outlets. We have, then, only to consider how the head of supply may be varied, and how the variation at any given point in the distribution system may be affected thereby.

Variations in the head of supply may be produced by the following methods:

By increase in speed of pumps used for supply until the increase of pressure is such that the pumps slacken speed again and continue to deliver the quantity into the distribution which flows from the openings thereof, and by actual change of the supply from one level to another.

VARIATIONS OF PRESSURE PRODUCED BY SPEED OF PUMPS.

At every stroke of a pump a change of pressure occurs in the force main near the pump, and to a less degree a change occurs in the entire distribution. To lessen the extent of such changes air chambers are placed on the pump discharge, and in some cases upon the distribution system, although their object is then to lessen the effects of changes in the flow of water in the distribution caused by changes of openings or of speed in the pumps. For the same purpose relief valves and stand pipes are placed on the force main to prevent sudden changes of pressure in the distribution. Elevated storage reservoirs act, of course, as equalizers of pressure, but serve also another purpose in storing water, and thereby contributing to the permanence of the supply.

When no relief is given to the distribution other than the air chambers of the pumps, large changes of pressure are continually occurring.

The choice of means to amend is to be governed entirely by the external conditions as to the cost of construction and operation, and whether it is desired to make large changes of pressure in the distribution or not. It may be regarded as a fixed fact, that low pressure in the distribution pipes tends to reduce waste, and that high pressure tends to increase it, and therefore this is an important item if high pressure for fires is required, and also at what elevations such pressure is required. The extent of the distribution is also a very important factor, and, of course, the size of the pipes.

In cases where the cost of construction and operation is nearly the same, the order of preference is considered by your committee to be the following, for constant head of supply:

Storage reservoirs of large capacity, of which the works at Baltimore are an excellent example.

Storage reservoirs of small capacity, of which Cleveland may be considered an illustration.

Storage stand pipes of large capacity, as at Sandusky.

Stand pipes of small capacity, of which, perhaps, Louisville may be taken as the best example, for although an extensive storage reservoir is used, yet the water is pumped to a constant elevation, and passes up one portion of the standpipe and down the other.

Air chambers in place of stand pipes, of which the committee have no personal knowledge. For widely varied pressures, the order of preference is as follows:

Storage reservoirs at different elevations, of which the works at Cincinnati would afford the best example.

Storage reservoirs for low pressure, and stand pipe for high pressure, as at Henderson, Ky.

Stand pipes of small capacity, of which there are many examples where variations of pressure can be made by the pumps, but very few where such changes can be rapidly made.

Air chambers, on the distribution of which your committee have no personal knowledge.

In the opinion of your committee, pumping directly into the mains without relief should only be resorted to when no other expedient can be resorted to without largely increased cost.

The annual cost of operating, other things being equal, will be nearly in the order given above.

As a method of examining the flow of water and pressure in the distribution pipes, the committee venture to add, as an appendix to their report, a valuable paper by Mr. M. L. Holman, C. E., member of the Association, which, although written and printed for another body, is yet considered as a desirable addition to their labors.

The title of this paper by Mr. Holman is, "Graphical Methods of Studying Efficiency of Water Distribution Systems and Performances of Fire-Engines, as illustrated by the Burning of the Collier Lead and Oil Works, St. Louis, Mo." The paper is illustrated by fine diagrams, and, as a contribution to the literature of hydraulics, is of considerable value as bringing together a number of valuable formulæ. The chief authority on the subject consulted was the little book by Geo. A. Ellis, entitled "Work Done by, and Power Required for Fire Streams, as determined by Experiments made in the Springfield Fire Department by Chief Engineer A. P. Leshure."*

A question arose in the discussion of the paper as to the accuracy of Ellis' tables, and Mr. W. C. Stripe stated that after careful examination he had found the tables absolutely correct, and considered the book worthy the consideration of every water-works manager.

The Committee on "Records" called from Mr. J. J. R. Croes the statement that he had been for some time engaged in collecting for publication in ENGINEERING NEWS just the information called for in the Report. He thought the collection made by himself would fully cover the ground, as he did not propose to stop until he had obtained statistics from every water-works in the Union. As the statistics, when completed, would be published in book form, the result of the discussion was the acceptance of the Report, and that the subject matter be referred to a committee consisting of Messrs. Croes and Wood, with the request that Mr. Croes embody the facts in his "History and Statistics of American Water-Works."

AIR CHAMBERS.

Mr. PLATT, of the Mohawk and Hudson Manufacturing Company, spoke at some length from his experience of the importance of air chambers in preventing the bursting of pipes.

Mr. G. A. PEARSONS, following, said the discussion shows that the use of air chambers on street mains is practically unknown to the members of the Association. At Kansas City, being very much annoyed by the use of elevators, and the air chambers at the pumps being small, he placed one on the main about midway between the works and the center of the city, choosing a location where it was hoped that the air from the mains would keep it supplied. Unfortunately this did not prove to be the case, and it soon filled with water. While in use, however (which is as much of the time as the business of the street superintendent will allow taking care of it), it has proved a very valuable adjunct to the system, taking away all pulsations from the mains and leaving the actions of the pumps almost as smooth and uniform as if pumping direct into a reservoir. In his opinion the real need of the direct pressure system is something of this kind which will act, so to speak, as a balance-wheel to the whole system, and the nearer it can be placed to the location of disturbance of pressure the more effective it will be. The inertia of water in long lines of pipe with its attendant water-ram is so great that such relief is not only a matter of convenience, but will prove on investigation worthy of being called a matter of necessity. In this connection he would state that he has patented a stand pipe designed for this purpose, and which is at the service of any member of the Association without royalty. The reason for excessive pressure on a pump-barrel far exceeding in some cases the effect produced on the accumulator, is, that the great weight of the plunger and its load may not be able to respond to the sudden shock of the plunger, by reason of the time of duration of the shock not being sufficient to overcome its inertia.

Air, when confined with water at high pressure, seemingly commencing at about 80 lbs. pressure and increasing with the pressure, is absorbed by the water, so the space is sooner or later filled entirely with water. The difficulty of keeping air chambers charged under high pressure is no doubt the cause of their being omitted with accumulators, which are in such cases intended to perform the work of both.

Mr. BRIGGS said very large air chambers were in use in his works, and he had never noticed any vibration of the needle except when some leak was discovered.

Mr. PETER MILNE, JR., of Brooklyn, on the subject of "Plumber's Work," responded in a very able manner, detailing the difficulties and losses to which water companies were subjected by reason of the faulty work of plumbers.

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* For sale at this office. Price $1.50.

Mr. W. C. **STRIPE**, of Keokuk, presented a paper as follows on

WATER MOTORS.

My short experience of five years as a water-works man has taught me that we are subject to many impositions at the hands of our patrons. Some will make contracts for specific purposes and use the water for other purposes indiscriminately. Many waste water in a hundred ways—leaky pipes running at night to prevent freezing—carelessness in manipulating baths, water closets, and other appliances, etc., etc. But for cool, deliberate, unqualified imposition, commend me to the water motor. These are advertised to be economical and effective—running at a very small expense for water, in fact (if you take the *ipse dixit* of the dealer) anywhere if it be only a little *damp*.

I have before me an editorial clipped from a newspaper published in Iowa to this effect.

OUR NEW MOTOR.—About two months since we dispensed with our three-horse power engine, and commenced running our presses, consisting of a 30 × 52 Cottrell & Babcock, one-half and one-quarter medium Gordon's, by one of Tuerks No. 5 (8 inch) Hydraulic Motor, and so far have every reason to be satisfied with the change, the Motor working to our entire satisfaction. The expense for fuel and oil, to say nothing of the time required to attend to the engine, by the old process, averaged twenty dollars per month, while the water tax, at fifteen cents per thousand gallons, accurately metered, foots up seven dollars and eighty cents per month. We are satisfied these motors are cheaper, safer and more convenient than steam, and that they can be used to advantage (in towns and cities having water-works) in propelling machinery requiring five-horse power or less.

(Putting faith in the truth of this statement we were induced to contract for a supply of water for a precisely similar motor for the consideration of $150 per annum.)

Now, sir, I contend that that item was paid for by the motor man to advance the sale of his machine, as a proof of which that identical motor is now in operation at the same locality, and the same water company now charge $250 per annum for water to run it.

A motor on the piston and cylinder principle is comparatively honest, but a rotary one is the greatest waster of water in existence. If nature furnished the water at sufficient altitude from the motor, it alters the case; but if direct pressure is the principle of the water-works, or water has to be pumped to a reservoir to produce the head, then I assert that a rotary water motor is the most patent mode of expending much power to produce little effect in the whole range of mechanism.

Given that your motor is located 50 ft. above your pumps, you lose by so raising the water, and by friction 25 to 30 lbs. per inch, and greater loss still in proportion to altitude and distance.

Again, all rotary motors have much slip—the effective power secured being only by impact or percussion on the periphery of the wheel—pressure, per se, having but little to do with it. All things considered, I hold that from ½ to ¾ of the power taken from the water-works engine is lost, and not at all utilized by the motor. I have arrived at this conclusion by means of actual experiment and know that I am correct. If others doubt this, let them make the experiment and I will cheerfully acknowledge my error if such be found. At any rate the subject is of interest to all of us, and the truth is what we are in search of.

Mr. **JOHN C. KELLEY**, President of the National Water Meter Co., New York, then, on invitation, read a very able paper on "The Benefits of the Meter System as Shown by Practical Results," a copy of which can be had by addressing Mr. Kelley at 51 Chambers street, New York.

Mr. **THOMAS J. BELL**, Chairman of the Committee on Engine Duty, made a short report, which was accepted and placed on file; and at the same time addressed the convention on the subject of his Waste Water Meter Detector, which has proved very successful in Cincinnati, O. Mr. Ira A. Holly read a paper on "Rates and Revenues, Wastage and Meters." Mr. J. G. Briggs, of Terre Haute, read a paper on "Experiences in Buying Water-Works Machinery." The topics for the next meeting, which is to be held at Buffalo, N. Y., March 15, 16 and 17, 1883, will be found farther on.

A banquet at the Neil House followed the adjournment of the convention.

OFFICERS FOR 1882-3.

President.

Col. J. T. Foster, Chicago, Ill. (Union Stock Yards).

Vice-Presidents.

J. G. Briggs, Terre Haute, Ind.
W. C. Stripe, Keokuk, Ia.
J. James R. Croes, New York City, N. Y.
Thomas J. Bell, Cincinnati, O.
Edwin Darling, Pawtucket, R. I.

Secretary.

J. H. Decker, Hannibal, Mo.

Treasurer.

Horatio D. Wood, St. Louis, Mo.

Executive Committee.

Officers above, *ex-officio*.

The third annual meeting will be held at Buffalo, N. Y., March 15, 16 and 17, 1883.

TOPICS FOR DISCUSSION AT NEXT MEETING.

I. The consumption of smoke, or smoke burners of water-works boilers. Ira A. Holly, Burlington, Ia. II. The relative economy of constant and intermittent pumping. W. C. Stripe, Keokuk, Ia. III. The methods of filtration of water in use in the United States and Europe, with details of construction, cost and efficiency. J. James R. Croes, New York city. IV. The relative economy to towns of a supply of water under municipal control; and under control of private corporations. J. G. Briggs, Terre Haute, Ind. V. Plumbing work; its effect on the health of the family. Peter Milne, Jr., Brooklyn, N. Y. VI. The operation of hydraulic elevators; difficulties found in their service and remedies for the same; also, amount of water used by water motors supplied from mains. B. F. Jones, Kansas City, Mo. VII. Subsidence and filtration of western river waters, and availability of natural flow into filtering wells and galleries. G. W. Parsons, Kansas City, Mo. VIII. The use of iron or steel tanks. J. Bell, Cincinnati, O. IX. Systematic compilation of annual reports. J. T. Foster, Chicago, Ill. X. Records of engine duties. Frank W. Holly, Lockport, N. Y. XI. How can the quantity of water passing through a water main, which is in operation, be ascertained. Geo. A. Ellis, Springfield, Mass. XII. How important a factor in the economic management of water-works is engine duty? Is its importance over-estimated or brought forward so as to cause less consideration of other important items of economy than should be given them. Prof. Chas. A. Smith, St. Louis, Mo. XIII. Repair and maintenance of machinery, valves, hydrants, etc., data and comparative cost of maintenance of different pumps, valves, hydrants, etc., with observations. Thos. J. Whitman, St. Louis, Mo.

The President stated that the Executive Committee had selected these from among the many topics presented for their consideration, and in making the assignments had done so to the best of their judgment. He hoped that each member to whom a topic had been named would fulfill his duty to the best of his ability.

LIST OF MEMBERS OF THE AMERICAN WATER-WORKS ASSOCIATION.

Active Members.

Axtell, S. P., Columbus, Ohio.
Baldwin, John R., Montgomery, Ala.
Ball, Phineas, Worcester, Mass.
Belcke, H. G., Peoria, Ill.
Bell, Thomas J., Cincinnati, Ohio.
Briggs, J. G., Terre Haute, Ind.
Brown, Calvin S., Toledo, Ohio.
Burnham, William H., Batavia, Ill.
Cameron, W. L., Memphis, Tenn.
Cannon, H. W., Stillwater, Minn.
Chase, M. X., Bloomington, Ill.
Clark, H. A., Chicago, Ill.
Colburn, Robert J., Chicago, Ill.
Croes, J. James R., New York, N. Y.
Darling, Edwin, Pawtucket, R. I.
Decker, J. H., Hannibal, Mo.
De Luce, Wm. T., Chicago, Ill.
Doherty, Frank, Columbus, Ohio.
Donahue, M., Davenport, Iowa.
Dyer, Sydney M., Indianapolis, Ind.
Ellis, George A., Springfield, Mass.
Foster, J. T., Chicago, Ill.
Gray, Carroll E., St. Louis, Mo.
Harrison, H. H., Stillwater, Minn.
Hely, John P., St. Louis, Mo.
Holcomb, D. I., Sedalia, Mo.
Holly, Ira A., Burlington, Iowa.
Holly, Frank W., Lockport, N. Y.
Holman, M. L., St. Louis, Mo.
Holme, Riccard, Jr., Denver, Colo.
Hoyt, Fred E., East Saginaw, Mich.
Jones, B. F., Kansas City, Mo.
Linneen, P. H., Lockport, N. Y.
Milne, Peter, Jr., Brooklyn, N. Y.
Molis, William, Muscatine, Iowa.
Moore, Arthur G., Cincinnati, Ohio.
Pearsons, G. W., Kansas City, Mo.
Quigley, J. B., Atchison, Kan.
Raeder, F. William, St. Louis, Mo.
Ratekin, William, Jacksonville, Ill.
Schon, Carl, Toledo, Ohio.
Sherman, William B., New Bedford, Mass.
Smith, Charles A., St. Louis, Mo.
Stanley, Orson G., Canon City, Col.
Stevens, G. C., Newport, R. I.
Stripe, W. C., Keokuk, Iowa.
Watts, Sylvester, St. Louis, Mo.
Whitman, Thomas J., St. Louis, Mo.
Wing, Fred, Kansas City, Mo.
Wood, Horatio D., St. Louis, Mo.

Honorary Members.

Bingham & Morgan, Buffalo, N. Y.
Blake, Geo. F. M'f'g Co., New York and Boston.
Chandler & Swift, Buffalo, N. Y.
Cincinnati and Newport Iron and Pipe Co., Newport, Ky.
Flower, James, Detroit, Mich.
Gaskill, H. F., Lockport, N. Y.
Goulds & Ostrander, St. Louis, Mo.
Jerecki, Hays & Co., Erie, Penn.
Long, Dennis & Co., Louisville, Ky.
Ludlow Valve M'f'g Co., Troy, N.Y.
McNiel, A. H., Burlington, N. J.
Michelson, James P., Gloucester City, N. J.
Mohawk and Hudson M'f'g Co. Waterford, N. Y.
Mott, J. L., Iron Works, New York, N. Y.
Mueller, H., Decatur, Ill.
National Meter Co., New York, N. Y.
Nelson, N. O. & Co., St. Louis, Mo.
Ohio Pipe Co., Columbus, Ohio.
Ripley & Kimball, St. Louis, Mo.
Roosevelt, C. H., New Rochelle, N. Y.
Shickle, Harrison & Howard Iron Co., St. Louis, Mo.
Union Water Meter Co., Worcester, Mass.
Wood, R. D. & Co., Philadelphia, Pa.

The Report, which should be read by every person interested in water-works, can be obtained from the Secretary, J. H. Decker, Hannibal, Mo. No price is named, of course, but it would be as well to enclose fifty cents, as it is worth it, and the expenses of the Association are very considerable.

PERSONAL.

A Paris despatch of the 11th states that "M. **DE LESSEPS** leaves for Egypt to-morrow."

MR. W. J. WHARTON is chief engineer of the Washington and Western Railroad; headquarters at Alexandria, Va.

CAPT. JAMES B. QUINN, corps of engineers, has been assigned to duty at St. Louis, and First Lieut. **WILLIAM H. BIXBY** to report at Willet's Point, N. Y., for duty with the engineer battalion.

GENERAL QUINCY A. GILLMORE, having declined to serve on the commission to examine and report as to the safety of the New Capitol at Albany, Gov. Cornell has appointed Prof. **WILLIAM P. TROWBRIDGE**, of Columbia College, as the engineer member of the commission.

THE KING OF SIAM laid the foundation stone of a new temple a few weeks ago, making a brief speech on the occasion. One remark was especially expressive. "In laying it," said his Majesty," "I announce that its name shall be—'Pratommahorommarachanusawari.'"

Mr. **ALEXANDER L. MASSEY**, a well-known engineer of Philadelphia, died in London, England, June 30, aged 58 years. Mr. Massey was President of the Bell's Gap Railroad Company, the Penn Gas Coal Company, the Youghiogheny Coal Company and the Millwood Coal & Coke Company.

THE family of General **ANDREW A. HUMPHREYS**, U. S. A., formerly Chief of Engineers, intend to spend the summer at Rye Beach, New Hampshire, where General **HUMPHREYS'** son, Colonel **HENRY H. HUMPHREYS**, captain Fifteenth Infantry, will accompany them. General **HUMPHREYS** will leave later in the season.

ENGINEER CORPS, U. S. A.—The Senate has confirmed the following nominations:

Army.—Corps of Engineers—Lieut.-Cols. C. A. Stewart and C. E. Blunt, to be Colonels; Majors O. M. Poe and D. C. Houston, to be Lieutenant-Colonels; Additional Second Lieuts. O. T. Crosbie and L. H. Beach, to be Second Lieutenants.

COLONEL JOHN W. BARLOW, Major of Engineers, U. S. A., met with a narrow escape from death recently at New London by drowning. He, with an assistant, Captain **ALBERT H. COMSTOCK**, were in a small skiff going from the dock to the engineer department surveying vessel, Alice, which was moored in Shaw's Cove, when the frail craft capsized, and the two occupants were rescued with much difficulty just in time to save life by a boat sent from a tug at the wharf.

A BOARD of officers, consisting of Cols. ZEALOUS B. TOWER and JOHN NEWTON, and Lieut. Col. HENRY L. ABBOTT, corps of engineers, has been ordered to meet at New York City to examine the following officers for promotion: Capts. WILLIAM LUDLOW, ANDREW M. DAMRELL, CHARLES J. ALLEN, and CHARLES W. RAYMOND, and Second Lieuts. HARRY F. HODGES and JAMES G. WARREN, corps of engineers.

MR. JOHN SCULLEN, President and principal owner of the Union Depot Street Railroad, St. Louis, Mo., has been appointed General Manager of the Mexican National or Palmer-Sullivan Narrow Gauge railroad, and will leave for the City of Mexico, where his head-quarters will be, in a few days. His salary will be $25,000 per year. Mr. SCULLEN went West from St. Lawrence County, New York, and is well known in the West as a superior railroad man. He was chief contractor of the Missouri, Kansas & Texas under ROBERT S. STEVENS, and has been connected with other roads in the West.

DR. R. W. RAYMOND, Mr. J. C. BAYLES and Mr. CHARLES MACDONALD, representing a joint committee of the American Society of Civil Engineers, the American Institute of Mining Engineers and the American Institute of Mechanical Engineers, have issued a circular, announcing that it is proposed to erect in the Central Park, New York, a monument to Alexander Holley. This monument, which is to consist of a suitable pedestal in stone, with architectural and symbolic decoration, surmounted by a portrait-bust in bronze, will, it is estimated, cost about $10,000. Mr. Charles Macdonald, Treasurer, of 52 Wall street, will receive subscriptions, which will be periodically acknowledged.

COLONEL THEODORE B. SAMO, the well-known civil engineer, died a few nights ago at his residence, Georgetown, a suburb of Washington, D. C., after a long and painful illness. Colonel Samo was for many years employed on the Washington aqueduct, in charge until 1869, and afterward, until his death, as assistant to General Babcock and Colonel Casey, corps of engineers, the control of the aqueduct having been transferred by law to the Chief of Engineers. He was a gallant officer during the late war, and after his assignment to the charge of the aqueduct took a deep interest in the welfare of the District. He had been ill for a long time, and was brought to his home in Georgetown only last week from a trip which it was hoped would benefit him, but which failed to afford any relief. He was a man greatly respected in the community, and his loss will be deeply regretted..—*National Republican, Washington.*

THE CITY OF ALEXANDRIA.

DESCRIPTION OF THE PLACE—ITS EVENTFUL HISTORY.

The city of Alexandria was founded by Alexander the Great in 332 B. C. It was beautifully and regularly laid out and in the height of its prosperity comprehended a circumference of fifteen miles and contained 300,000 free inhabitants and as many slaves. The city lies low, and the approach from the Mediterranean is the reverse from picturesque. But few remains of the ancient city, which stood on the western mainland shore, opposite the island of Pharos, since converted into a peninsula, are now extant; its extent from east to west seems to have been four miles, traversed by two grand streets, each 100 feet wide. The Catacombs, the public cisterns and the column erected in honor of Diocletian, which is called Pompey's Pillar, with some portions of the Roman city wall, still remain to attest the traditions of classical antiquity. Alexandria owed its wealth and prosperity to the conformation of the sea-shore, with the shelter afforded by the small Pharos islet, providing a commodious harbor, called by the Greeks Eunostos, with good anchorage in deep water, on the western side. The eastern harbor, though it is called the New Harbor, has been little used, being exposed to the north winds, much clogged with sand and having a foul and rocky bottom. These two harbors are separated from each other by a broad causeway, or artificial isthmus, now joining Pharos to the mainland of Egypt. This tract of land, however, on the main, is of no great worth, lying between Lake Mareotis, to the west, and the Bay of Aboukir, eastward; while the Canopic mouth of the Nile is to the east fourteen miles distant. There is a connection with the Nile by the Mahmoudieh Canal, which extends from Alexandria to Fouah, a distance of forty-eight miles. The distance to Cairo is about one hundred and thirty miles by railway, but it is a journey of five hours. The ancient Pharos lighthouse is at one extremity of the island and the modern lighthouse at the other. The Khedive's palace of Ras-el-Tin is situated on the island, next the modern light-house and fort. The Arsenal is at the inner harbor; the Catacombs, on the southern shore, marking the site of the ancient city. The interior of the town itself presents no features of interest. There are the quays, with old-fashioned, rather squalid houses on the shore of the Old Port; the Arab quarter, to the south, consisting of mud hovels; the cotton market, the canal warves, the railway station and baracks, on the same side; to the east, facing the New Port, beyond Fort Napoleon, is the Grand Square, the Place des Consuls, or Frank Square, formerly called the Place Mahomet Ali, which has, with several adjacent streets, come to be chiefly inhabited by European residents. It was in the Rue des Sœurs "Sikket el Binnat," in this quarter of the city, that the frightful riots of Sunday, June 11, began, and simultaneously in two other places, and along the Marina. These parts of Alexandria seem to have been quite out of sight, as well as out of reach, of the British naval squadron lying in the harbor or in the outer roadstead.

The people of Alexandria, a various mixture of nations, united the vanity and the inconsistency of the Greeks with the superstition and obstinacy of the Egyptians.

Half the population of the city were swept away by the plague A. D. 250.

Caracalla ordered a general massacre of the citizens of Alexandria after he became Emperor.

During the reign of Constantine the struggles between the orthodox and Asian bishops deluged the capital of Egypt in blood.

During the reign of Valentinian and Valens 50,000 Alexandrians were drowned by an immense tidal wave.

The city was taken by the Saracens under Amron after a siege of fourteen months and a loss of 28,000 men and the famous library was destroyed. The volumes of this unequalled collection were distributed to the 4,000 baths of the city, and such was their incredible multitude that six months was barely sufficient for the consumption of the precious fuel. At this time Alexandria contained 4,000 palaces, 4,000 baths, 400 theatres, 12,000 shops for the sale of vegetable food and 40,000 tributary Jews.

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THE SUEZ CANAL.

The great water-way between the Mediterranean and the Red Sea, owing to the war in Egypt, has of late again been brought prominently before the public. A short sketch of its history will, therefore, not be without interest at the present moment.

In almost prehistoric times the Eastern branch of the Nile and the Red Sea were united by a canal, made under Necho and Ptolemy Philadelphus. Traces of it are still visible, but it is not known when it ceased to be a navigable communication.

In modern times Napoleon I., during his sojourn in Egypt, conceived the idea to reopen the canal between Cairo and Suez, and instructed the engineer, Lepere, to study the question. Lepere found a difference of 30 feet in the level of the two seas, and although his measurements turned out wrong afterward, the plan was abandoned.

In 1840, M. Linant de Bellefonds; in 1846, Enfantin; in 1847, M. Talabot and M. Barrault again proposed piercing the Isthmus, but could not find any one to listen to their projects.

It was in December, 1854, when M. de Lesseps first explored the desert along the Isthmus, and found the establishment of a canal feasible. To his indomitable energy it is due that the works were commenced in 1860, and the new water-way opened for traffic nine years later. During this time the harbor of Port Said, on the Mediterranean end, was constructed between two jetties of two and three thousand yards in length respectively. At Suez, the Red Sea was sufficiently protected from adverse winds to dispense with jetties and to inclose the canal between two quays.

The tract of low-lying land connecting Africa with Asia extends about 74 miles from north to south and is composed of shell limestone rocks mixed with strata of silicious limestone, and partly covered with sand or salt marshes. The deepest cuttings had to be made near El-Guisre, near Serapeum and Chalouf. Equi-distant from Port Said and Suez a new town, Ismailia, was built on the shores of Lake Timsah, to protect the outlet of a second canal, which carries the fresh water supply from the Nile, near Cairo to the Isthmus, distributing the same in two branches to Suez and Port Said.

The supply of fresh water was of the utmost importance when more than 20,000 laborers were employed in the construction of the canal, and is still a necessary of life for the towns of Port Said, Ismailia and Suez, as well as for the engineering staff which keeps the canal in repair and for the convenience of the shipping, considering that a supply of drinking water from wells can be obtained at one or two places only.

England, who at first opposed the construction of the canal, has since become fully alive to its political and commercial value as the shortest route to India, the distance between Bombay and London having been reduced—compared with the route round the Cape—by about 7,000 miles. The number of vessels, the greatest part English, rose from 1,477 in 1879 to 2,727 in 1881. It is, therefore, a matter of grave anxiety whether the safety of the passage can be depended upon in a crisis like the present one.

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"DE LESSEP'S DITCH."

The Suez canal is one of the greatest arteries of commerce that is apt to be more or less forgotten till brought to notice by some special circumstance, which in the present case is the prospect of trouble between England and Egypt. The work on the canal began under a charter for ninety-nine years, granted by the Viceroy of Egypt, November 30th, 1854, in 1859, and on the 15th of August, 1869, the waters of the Red Sea and the Mediterranean were mingled in the Bitter Lakes. The formal opening of the canal took place on the 17th of November, 1869. The canal proper is a broad and deep salt-water channel without locks, extending from Port Said to Suez, a distance of about 100 miles, one-quarter of the route lying in the "lakes" of the isthmus, in many of which excavations were necessary. The width of the canal, except in deep cuttings, is 325 feet at the surface, and 72 feet at the bottom, the depth of water being 26 feet. When it runs through high ground, as to the north of Lake Timsah, the width at the surface is 195 feet, with slopes of 2 to 1. The "fresh water canal," to which allusion is frequently made in the cable despatches, and which was designed for purposes of transportation and to supply water to the workmen along the line, begins at Zagazig, and carries the water of the Nile to Suez. It is navigable through its whole extent, changes of level being overcome by locks. At the Port Said terminus is a basin half a mile square; at Suez is a similar basin protected by a breakwater, the depth of water in each harbor being 26 feet.

From the following table, copied from the New York *Herald*, showing the growth of the traffic of the canal, it appears that in 1881 nearly half the steam vessels and much more than two-thirds of the steam tonnage of the world passed through this great artery:

Year.	Vessels	Tonnage.	Receipts
1870	486	435,911	$1,031,865
1871	765	761,467	1,790,746
1872	1,082	1,439,169	3,281,518
1873	1,173	2,085,072	4,379,464
1874	1,264	2,423,672	4,071,877
1875	1,494	2,940,708	5,777,200
1876	1,457	3,072,107	5,995,000
1877	1,663	3,418,949	6,354,800
1878	1,593	3,291,535	6,319,646
1879	1,477	3,236,942	5,887,212
1880	2,026	4,344,519	7,928,000
1881	2,727	5,794,900	10,254,800

Of course England makes the greatest use of the Suez Canal, but it is hardly realized, even in England, how important "De Lesseps's Ditch" is to her commerce. In 1870 she furnished 64 per cent. of the tonnage which sought that channel; in 1871, 65; in 1872, 70; in 1873, 69; in 1874 and 1875, 71; in 1876, 73; in 1877, 78; in 1878, 79; in 1879, 77; in 1880, 79, and last year, 82 per cent.

On Nov. 25, 1875, public announcement was made that Lord Beaconsfield had purchased from the Khedive of Egypt, through the intermediary of the Rothschilds, for the sum of £4,080,000, 176,602 out of 400,000 shares of £20 each, on which investment 5 per cent. interest was to be paid till July 1, 1894, when the shares were to receive interest. England receives no share of the earnings of the canal until 1894, but she receives her 5 per cent. upon her shares. There are three gentlemen who represent the British Government on the board, Col. Stokes, Mr. Rivers-Wilson and Mr. Stanley. The two former gentlemen attend every meeting of the board, and the latter is a resident director in Paris, and sends the Government information of everything that occurs there. England's total investment in the canal shares was a trifle under the £4,080,000 voted for the purpose, the Rothschilds' commission and other expenses coming to just about £100,000. Of the 5 per cent. on the purchase money which goes into the English treasury, 1½ per cent. is applied to the payment of the debt raised to purchase the shares. But England's interest is not to be measured by a money standard alone.

GRANITE BLOCKS.

Granite, having little grain, can be cut in blocks of almost any size and shape. Specimens as much as eighty feet long have been taken out, and transported great distances. The quarrying is done by drilling a series of small holes, six inches or more deep, and about the same distance apart, inserting steel wedges along the whole line, and then tapping each gently with a hammer in succession, in order that the strain may be evenly distributed.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The Park Water Company.—A certificate of incorporation of the Park Water Company, of New York, was filed in the County Clerk's office, on the 12th. This corporation is formed to supply water for mining, domestic, manufacturing, and agricultural purposes, and particularly to supply the city of Sacramento and other cities and towns of California. Its capital stock is fixed at $2,500,000, divided into 2,500 shares of $100 each. Its incorporators are Cole Saunders, Myron W. Bradley, and Charles N. Morgan, who, with Alexander T. Beach, Gustave S. New, William Nowlan, and John M. Coughlin, will form its Board of Trustees for the current year.

The city council of Decatur, Ill., closed a contract on the 8th with a Hudson, N. Y., company to supply the Decatur water-works with a new pump; capacity 3,000,000 gallors daily, for $8,700, the same to be in operation within one hundred days.

The proposed introduction of additional water meters in Boston, and of the Deacon waste-water meter, was defeated in council by a vote of 37 to 25.

The city of Davenport pays $564 per year for lighting the government bridge at night—the expense aggregating nearly $6,000 since the completion of the bridge.

The condition of the city's drinking water has improved somewhat of late, owing to cool weather and the copious rains that have kept the basins full, but it continues to excite some apprehension in the minds of consumers who are informed on hygienic subjects, and who, consequently, pass their lives under a cloud of fear that they may at any time swallow something which will cause sudden dissolution. It is evident that circumspection is necessary in the use of Cochituate, although one should be slow to commend the excessive caution shown by a substantial citizen who was seen to partake of a draught furnished by one of the public drinking fountains the other day. Immediately upon drawing the water he smelled of it cautiously, then examined it critically with a large magnifying glass which he took from his pocket, and finally, furtively extracting a flat black-glass bottle from the tail of his coat, he turned into the cup about a gill of reddish-brown liquid, evidently having an alcoholic base—perhaps it was some sort of cholera mixture—and swallowed the draught with an expression of countenance which seemed to indicate that he found it not altogether disagreeable. He then—actuated, no doubt, by the fear that the dregs of the potion might not agree with the next drinker's peculiar constitution—rinsed out the cup very thoroughly and went his way. Now we cannot all lug around microscopes, but almost everybody has a coat-tail pocket big enough to hold a phial of anti-febrile or anti-malarial specific.—*Boston Journal.*

Litigation About Gas.—Logan, O., July 11.—Last summer the Logan Council contracted with McDonough & Co., of Cincinnati, who built the Logan Gas-works, to light the city at so much per post for the term of ten years. When the new Council went into office, in April, they refused to pay the gas bills for April and May, claiming the contract was illegal, on the ground that it had not been left to the voters of the city. The Gas Company took it to Court. The case was tried before Judge Friesner at the June term of Court, and he renders his decision in favor of the Gas Company. The Council will carry it to the District Court.

Will Build Water-works.—The Common Council of Orange, N. J., on June 30, passed an ordinance creating a "Water Committee" to erect and maintain water-works for the city, and authorizing an expenditure of $400,000.

Medina, O., finds an inexhaustible supply of water at a depth of 160 feet.

Filters.—From the *Republican* of Springfield, Mass., we clip the following communication:

To the Editor of the Republican:

A short time ago my attention was drawn to the sand filters used at the Southworth Paper Mill at Mittenague and the excellent water obtained by them. These filters are two big boxes 100 by 12 ft. and 3 ft. deep: the bottom is common board in two layers, laid crossways, covered with coarse gravel, and finally common sand, so abundant everywhere around here. Only one sand-bed is used, the other being kept as a reserve; the one used filters a stream of water 6 in. square, flowing with a speed of about 4 ft. a second, or about 1 cu. ft. a second, and about 500 gallons a minute. The water flows over the top surface from a common wooden channel, and filters so rapidly that it is visible only half the length of the sand-bed. The Water Commissioners, too, are experimenting in the line of filtering through sand, but their galleries, while no doubt excellent, seem more expensive than these sand-beds. Supposing there was in the city of Springfield a consumption of 100 gallons of water per head, and per day (a very high estimate), we would have a consumption of 3,500,000 gallons a day, or 350 cub. ft. per minute. To filter this amount a bed of sand of 7,200 sq. ft. would be required, supposing that the rate was the same as at Mittineague; this would practically require the following construction: A ditch about 9 ft. deep, 300 ft. long and 24 ft. wide at the outlet, filled half way with coarse stones, the bottom of boards loosely laid, and afterwards gravel and about 3 ft. sand; the top of the sand would be left free and from a wooden channel, the water of the pond being distributed all over the sand surface, would filter through the sand and flow through the lower part of the ditch, which gives ample space, into the pipes. The cost of such a ditch, etc., could not be very heavy: probably $2,000 would cover all. At Mittineague the filters are used all the year round, the surface being renewed now and then by skimming it with a shovel. The sand is changed once a year. In the meanwhile the water filters through the other sand-bed. This principle, by the way, is used in the densely-populated parts of Europe, where the water of rivers has to be used for drinking purposes, as far as water is drunk. Hamburg and Berlin have systems of filtering which are a combination of the galleries proposed by the water commissioners and the sand-beds used at the paper-mill. C. M.

Springfield, Mass., July 11.

STREETS, DRAINAGE, ETC.

Draining Black Rock Tunnel.—The Philadelphia & Reading Railroad have had a survey made for the building of a viaduct at Phœnixville to carry the water that falls at the southern end of Black Rock tunnel over the railroad into a drain leading under the canal into the Schuylkill River.

New Sewer Wanted.—The city engineer of Toronto has recommended, on sanitary grounds, the building of a sewer on Church street from Gerrard southward.

The National Association for Sanitary and Rural Improvement has just had an annual gathering at Greenwood Lake, New York. The name of the organization and some of the papers read sufficiently indicate its object. Considerable time was given to the discussion of tree planting as a factor in rural improvement and to the wholesale destruction of forests in the West—a destruction so wanton that the best-informed dealers fear that in 10 or 12 years there will be no more lumber to be obtained in the great lumber states—Michigan, Wisconsin and Iowa. Ex-Gov. Frank Fuller, of Utah, read an interesting paper showing the evils of the modern system of cooking, which sacrifices the good of the body to taste. In its course he declared that "from the annual strawberry period the most serious forms of intestinal lesion date, owing to the sharp insinuating, burrowing seed of the berry. These injure the alimentary canal, cause cul de sac cavities, leading almost necessarily to fistulous openings oftener than all other causes combined." He prophesied that the time would eventually come when only the juice and pulp of these small, seedy fruits would be eaten. In the course of a talk on "Tenement-house Reform," George C. Barth of New York city stated that there are 20,000 tenement-houses in that city which accommodate from four to forty families each, and 8,000 that accommodated from two to four families apiece. And he declared that "the wealthiest church corporation in the city owned scores of the worst and foulest, and would pay no attention to their sanitary condition, nor heed the instructions that is preached to them by liberally paid pastors, but squeezed from the poor every cent possible, evicting tenants who for any reason get behind in their rentals, and who last May increased the rentals from ten to fifteen per cent." The association adopted a resolution applauding the work done by the national board of health and decrying the proposed congressional limitation of its means and functions. Erastus Brooks of New Brighton, S. I., has been made president of the association. At the conclusion of the discussion on the papers presented, a permanent organization was affected under the title of the "National Association for Sanitary and Rural Improvement." The following are the officers elected: President, Hon. Erastus Brooks, New Brighton, S. I.; Vice-Presidents, Henry E. Pellew, New York; Frederick Law Olmsted, Brookline, Mass; Col. Geo. E. Waring, Jr., Newport, R. I.; Prof. Henry Morton, Stevens' Institute, Hoboken, N. J.; Isabella Beecher Hooker, Hartford, Conn.; Secretary, Charles F. Wingate, Brooklyn; Treasurer, Harvey E. Fisk, West Ewing, N. J. Executive Committee, Hon. Frank Fuller, N. Y.; Jas. C. Bayles, Orange, N. J.; Dr. R. H. Storer, Newport, R. I.; Mrs. H. M. Plunkett, Pittsfield, Mass.; Rudolph Hering, Philadelphia, Pa.; Dr. D. F. Lincoln, Geneva, N. Y.; Prof. J. Madison Watson, Elizabeth, N. J.; Prof. Albert Leeds, Stevens' Institute, Hoboken, N. J.; Mary Putnam Jacobi, New York; Louisa Lee Schuyler, New York; Mrs. Josephine Shaw Lowell, New York; Dr. Alfred L. Carroll, New Brighton; Maurice Fornachon, Paterson, N. J.; Dr. J. H. Pinkham, Montclair; Dr. C. F. Folsom, Mass.; Wm. O. McDowell, Warwick Woodlands; Dr. A. N. Bell, New York; Edward Dunn, Newark, N. J.; Dr. J. H. Kidder, Washington, D. C.; William Blaikie, Englewood, N. J.; M. C. Heath, M. E., New York; E. P. Roe, Cornwall-on-Hudson, N. Y.; Dr. Pinkham, Lynn, Mass.

Proposals for Paving.—The City of Holyoke, Mass., will receive proposals for paving up to July 17.

RIVERS AND HARBORS.

Meeting of Hydrographers.—An effort is being made by the hydrographic officers of several nations to have called an international convention of Hydrographers, to consider a number of subjects of interest to navigation with a view to making the system of charting and references uniform among all the maritime nations. Among the points to be considered is the method of describing magnetic bearings, some nations giving the bearings from the lights or headland, while others are from shipboard. Another is the necessity of adopting a uniform method of charting, and of indicating depths of water, and all nations recognize the necessity of the adoption of a prime meridian. The latest nation to issue hydrographic charts is the Japanese, whose work is of the highest character.

In 1878 Congress appropriated $300,000 for the improvement of the Harlem River, with a view of making a wide and deep channel from the East River to the Hudson, and in 1879 the sum of $100,000 was added, all conditioned upon the gaining of a right of way without expense to the United States. Memorials were presented in the House this week by Messrs. Dunnell, of Minnesota; Converse, of Ohio; Duester, of Wisconsin; Hiscock, of New York, and Cox, of New York, urging that some use be made of this money in constructing the proposed improvement. The memorial was signed by many prominent business men of New York and elsewhere. Mr. Charles Stoughton offers to make a channel 225 feet wide and 15 feet deep on the proposed lines for $1,375,000.

TUNNELS.

The North River Tunnel.—During the last week 25 feet of completed work has been done in the North River Tunnel at the Jersey side. The total distance now completed on that side is 1,197 feet in the north tunnel and 562 feet in the south tunnel. The heading of the north tunnel having been advanced 475 feet from the inner air-lock, a new air-lock is now being set up 20 feet from the heading. An auxiliary air-lock for passing timber is being put in the same bulkhead. In the north tunnel, on the eastern side of the river, the plates of the new section, which is 15 feet long, have been carried down about two-thirds of the circle. The earth has improved sensibly, and less difficulty has been met than heretofore. The steam power on this side has been found inadequate to supply the air-compressors, and a large boiler is being set up to supplement those already in use.

RAILROADS.

An Expensive Enterprise.—A Boston exchange says: "The Leavenworth, Topeka and Southwestern Railroad Company, of Kansas, which recently made a mortgage to the American Loan and Trust Company, of this city, for $1,500,000, has found that railroad-building is expensive. To build fifty-eight miles of road between Leavenworth and Topeka, the promoters organized a construction company with $500,000 capital, and $465,000 in cash was paid in. This has been expended, and now the construction-company subscribers have got to put in another $500,000 to get their road into the capital of Kansas, for the road will cost nearly $20,000 per mile. At a fair price for the bonds now being issued at the rate of $25,000 per mile, the construction company may get a new dollar for an old one.

The engineering staff of the Kingston & Pembroke Railway Co. has been camped near the village of Renfrew, Ont., for the last few weeks, and are engaged in looking out a site for their railway, between that place and Calebogie, a distance of about thirteen miles. They have explored several routes, but have not as yet, so far as can be learned, located the line.

Change of Route.—It is proposed to build a line of rails from the Bangor & Portland road, beginning at a point four miles from Martin's Creek, run down the west bank of the Delaware through Easton and connect with the Lehigh & Susquehanna road between Easton and Bethlehem, Pa. This would make through connection from Philadelphia to the Delaware Water Gap, and the distance would be 28 miles less than by way of the Belvidere Delaware road. The Reading system would embrace this road.

Among the charters which have just been granted by the State Department was one to the Tionesta & Clarion Railroad company, which proposes to build a road from Eagle Rock to Fairmount, Clarion County, a distance of 50 miles. Its proposed course is through portions of Clarion, Venango and Forest counties. The capital stock is $1,000,000. The principal officers are to be in Philadelphia. The directors are: John W. Jones, President; George F. Tyler, E. A. Rollins, B. K. Jamison, C. H. Clark, H. M. Sill and Joseph R. Trimble, of Philadelphia; Archer N. Martin, Summit, N. J.; H. A. V. Post and Charles Pomeroy, New York.

A charter has also been granted to the Bradford & Tiona Railroad Company, which proposes to build a narrow gauge railroad, 12 miles in length, to connect with the Garfield & Cherry Grove Railroad. Alonzo J. Wilcox, of Bradford, is President. A charter has also been granted to another company, which has in view a railroad from Garfield, Warren County, to Tionesta, Forest County, a distance of 28 miles. Asabel N. Cole, of Wellsville, N. Y., is President of the road.

Canadian Pacific.—General Manager Van Herne, Chief Engineer James and Superintendent Egan returned on the 9th from a trip to the end of the Canadian Pacific Railway west. They report over 4,000 men and 2,000 teams at work on the construction of the main line west. Rails have been laid to a point 116 miles west of Brandon, to which point a telegraph line has been also constructed. The grading is completed some 30 miles further west, which carries the graders out of the wet lands that have hindered construction for some weeks. The present terminus of the track-laying will be made the end of the second division.

The Montreal, Ottawa & Western Railway Company, which was the original company to get a charter for the present Quebec, Montreal, Ottawa & Occidental Railway, and built the road from Montreal to Aylmer in 1875, to-day commenced the work of continuing the road from St. Jerome to St. Agathe, thence following the valley of the Red River, to tap the Gatineau Railway at Desert, 100 miles from Ottawa, thence in the direction of Lake Temiscamingue, to join the Canadian Pacific Railway. The total length will be about 200 miles.

The Kankakee Valley Railroad Company was organized at Laporte, Ind., on the 5th ult., with a capital of $1,600,000. The plan is to dredge and straighten the Kankakee River from South Bend, Ind., to Momence, Ill., draining a large area of overflowed lands, and use the dirt obtained by dredging to grade the road. The Directors are Clem Studebaker, J. M. Studebaker, Judge Stanfield and A. S. Baker, of South Bend; General Gleeson, W. B. Biddle, E. H. Scott and

M. Ney, of Laporte; W. E. Pinney, of Valparaiso; Thos. J. Wood, of Crown Point; General George W. Cass, W. F. Singleton and E. Lamphere, of Chicago. The incorporators are all leading business men.

Street Railway.—Books of subscription to a street railroad will be opened soon in Birmingham, Ala.

R. R. Extension in Virginia.—A corps of engineers has been organized for the extension of the Washington and Western railroad (late Washington and Ohio) from its present terminus to Winchester, and will begin work Monday.

The Toronto and Ottawa.—Work on the Toronto and Ottawa Railway has been begun on the farm of John Woods, near the village of Arden. The operations are conducted east and west. The whole line has been located and grading is now being done. Between sixty and seventy navvies are engaged at this work, under the supervision of Mr. Quinlan, of the firm of Quinlan & Stewart, St. Ann's, who have a contract on ten miles from Sharbot Lake.

The Atlantic & Pacific.—Work on the Atlantic & Pacific Railroad at Mohave is moving forward slowly. The track has been laid east 21 miles, and graders and surveyors were out 20 miles further at last accounts.

A Southern Project.—The *Gainesville Southron* says enthusiastically: "We are glad to be able to say positively that the Gainesville & Dalton Railroad will be speedily built. The parties having the enterprise in hand have made arrangements for all the capital required, and now nothing remains to be done except to go to work and build the road."

The Connotton Valley Railway is now in operation from Cleveland, O., to Sherrodsville and Minerva (108 miles) and in process of construction from Canton to the Hocking Valley (120 miles). The capital of the company is $5,000,000, and the authorized issue of bonds, $7,000,000. The receipts of the road on July 4th were $3,000, and the gross earnings are increasing steadily at the rate of about 15 to 20 per cent. per month. The headquarters of the the company is 13 Exchange St., Boston, Mass. The President is Francis Bartlett, Esq., and the Treasurer is Wm. Rotch, Mem. A. S. C. E., recently of the Mexican Central Railway.

Canada-Atlantic Railroad.—*The Boston Journal's* Vermont correspondent, writing from Alburgh Springs, says: The work of construction on the Canada-Atlantic Railway is rapidly progressing, and that portion of the line between Coteau Landing and Ottawa, a distance of 82 miles, will be completed before Aug. 1. The Track layers are within a few miles of the Dominion Capitol. The route of the line from Valleyfield on this side of the St. Lawrence, opposite Coteau Landing, has finally been decided upon and the locating survey completed. The road will cross the Richelieu or Sorel River, in the township of Lacolle, a portion of Ash Island being utilized for bridging purposes. The plans and specifications for the new bridge are made, and work on the structure is in progress. Ground has been broken for the approaches. The Canada-Atlantic will enter Vermont in the town of Alburgh, where connection will be made at Alburgh Springs with the Central Vermont Railroad system. Several hundred thousand ties for this section of the road have been contracted for, to be delivered at Lacolle, and 5,000 tons of English steel rails have been purchased for this portion of the Canada Atlantic. From this time forth the work will be vigorously prosecuted, and it is expected that the present year will witness the opening of the entire line between Alburgh Springs and Ottawa for business. The great advantages to the commercial interests of Boston that will inevitably accrue on the opening of this new short line to the Ottawa lumber region and the vast grain fields of the Northwest cannot be overestimated.

The Canada Pacific.—Canadian advices state that the Canada Pacific Railroad has purchased the rights of the Southeastern Company, which has a charter for a railway from opposite Montreal to the Provincial line. The object is to prevent American companies from making connections from Montreal to Chicago on the American side. The Great Eastern, however, has a charter also for a road from Montreal to the Provincial line, but there is no immediate prospect of the work going on unless it is undertaken by American railway men, in which case the road will be continued to opposite Quebec and join the Intercolonial with Halifax as its terminus. The Canada Pacific will not build a bridge over the St. Lawrence River, but construct a tunnel at the lower end of the city. The determination of the Pacific to compete with the Grand Trunk and American system is evident in this.

Two Locomotives Daily.—The Louisville & Nashville Railroad is receiving two new locomotives a day from Eastern works.

A New Indiana Road.—The Kansas Valley Railroad Company has been organized at Laporte, Ind., to build a road from South Bend to Momence. The capital stock is $1,600,000, and the Studebakers are enlisted in the enterprise. It is proposed to dredge and straighten the river, and use the dirt to grade the road-bed.

Work Suspended.—Work on the Georgia Pacific Railroad, from Columbus eastward, has been suspended.

A Costly Railway Station.—It is rumored in Montreal that the Canadian Pacific Railway Company is in treaty with the city for the site occupied by the Bonsecours Market, and with private parties for the site of the Bonsecours Catholic Church, the oldest church in the city, and a commercial block, thus giving them access to Jacques Cartier square, on which they will erect a station to cost $1,000,000. Jacques Cartier square is quite central, and the scheme, though a gigantic one for Montreal, is quite feasible and will be very popular.

South Pennsylvania R. R.—The surveyors are making good progress on the two new lines of railroad to be laid out in that portion of the State lying between the Susquehanna and Ohio Rivers. One of these lines, the South Pennsylvania, will start from Marysville, a few miles from Harrisburg, and will run from that point across the Allegheny Mountains, through Somerset county, thence to Connellsville and Uniontown across the Monongahela, and by way of Waynesburg to Wheeling. The other road, the Pittsburg & Atlantic, proposes to commence at Chambersburg and pursue the same general route as the other company until after the Allegheny Mountains are crossed, after which they descend the Youghiogheny River to Connellsville, where the line will end. At that place it will make a connection with the Pittsburgh, McKeesport & Youghiogheny R. R., now in course of construction.

[This proposed line, which recently had 80 corps of engineers at work, now has only two; the contracts which were to have been let some time ago, "hang fire." In 80 miles there are 6 miles of tunnels located. Oliver W. Barnes is Chief Engineer, and New York City is headquarters.]

Virginia Railroads.—The Virginia legislature during its session of 1881 and extra session of 1882 passed acts as follows regarding new railway enterprises. We clip the summary from *The Virginias:*

Virginia Coal and Iron Co., incorporated, with power to buy and sell real estate, mine coal, iron ore, etc., to construct and operate a railway or railways from any point on Norfolk & Western or Bristol Coal and Iron N. G. R.'s in and through Lee, Wise, Buchanan, Dickenson, Scott, Russell, Tazewell and Washington counties; to erect and operate furnaces, mills, etc. Its annual meetings are to be held at Alexandria, Va.

Saltville & Coal Mine R. Co., charter amended and name changed to Norfolk & Cincinnati R. Co.; authority granted to construct and operate lines of railway from any point on Norfolk & Western R. between Emory and Wytheville through Washington, Smyth and Wythe counties to any point or points on Ky. or N. C. lines, or to any road leading to tidewater, and by such routes as it may deem most advantageous for developing the resources of the country traversed. It and the Bristol Coal & Iron N. G. are prohibited from occupying exclusively any mountain pass.

Henrico R. Co., incorporated to construct and operate a railroad from Hungary station of R., F. & P. R. through Henrico and Goochland counties to James River in those counties, with power to extend same from Hungary to any point on C. & O. R. in Henrico or Hanover.

Richmond & Southwestern R. Co. consolidated with Kentucky & Ohio Narrow-gauge R. Co., joining their rights and privileges, and changing name to Richmond & Louisville R. Co., and authorizing new company to extend its road from, at or near New River depot to, at or near Portsmouth, and to build a branch up New River to N. C. or Tenn. lines.

Bristol Coal & Iron Narrow-gauge R. Co. changed to South Atlantic & Ohio R. Co., and authority granted to extend line or build branches to any point or points on Ky. line in Lee, Wise, Dickenson or Buchanan.

Iron Belt R. Co. incorporated with authority to construct and operate a railway from James River at or above Buchanan, by the most practical and suitable route, " to the most suitable point above the narrows of new River, in the State of Virginia," and to construct and operate branch roads to bring out coal, iron and other ores, etc., from Botetourt, Craig, Roanoke, Giles, Bland, Tazewell, Russell, Wise, Buchanan, Montgomery, Pulaski, Wythe, Carroll, Grayson, Smyth and Washington Counties, and to acquire and use land for mining and manufacturing purposes, etc.

Virginia Mineral & Gypsum R. Co., charter amended changing name to Virginia Iron Trunk R. Co. and granting authority to construct railway from, at or near mouth of Catawba or Craig creeks in Botetourt, through Botetourt, Craig, Giles, Bland, Tazewell and Russell counties, passing near Bickley's mills, on Saltville & Coal Mine R., and thence down Clinch river or through Big Moccasin Gap, in Scott county, to Tenn. line, with power to extend its road to Lexington, Va., and to build 10-mile branch roads to mineral lands, and to own and work mineral lands.

East River R. Co. of W. Va., authorized to construct parts of its line in Va. and to extend it by any route it may select and from either end or both ends of its line in W. Va. to any points in Giles, Tazewell, Buchanan and Dickenson counties, and granting the privilege of consolidating, by change of name or otherwise, with the Norfolk & Western R., the New River R. Co. of Va. and the New River R. Co. of W. Va.—but it may not consolidate with any parallel or competing line.

Virginia & West Virginia Railroad Company incorporated to construct a railway from any point on W. Va. line in Frederick or Shenandoah counties and thence to Alexandria or any point above it on the Potomac. If it does not connect with the Manassas Gap Railroad, then Winchester is to be a point on its line. May consolidate with any railway in W. Va., Va., or Md., and may build branches of any gauge as much as 20 miles long.

Fauquier & Rappahannock Railroad Company incorporated to construct a railway from any point on Va. Midland Railroad or branches to Sperryville, Rappahannock county, running to or within a mile of Washington, the county seat of that county.

Allegheny Railroad Extension Company incorporated to construct a railway from any point on the main line or branches of Richmond & Allegheny Railroad west of Lynchburg to any point or points on W. Va. state line via Craig Creek or Jackson River, or any tributary of James River, with authority to consolidate with Richmond & Allegheny Railroad, and with any railway wholly or partly in W. Va. that will form a connecting line of railway with the Allegheny Extension Railroad.

Massanutton & North Mountain Railroad Company, incorporated for constructing a railway through Warren, Page, Shenandoah, Rockingham, Augusta, Bath and Highland counties from some point on Manassas Branch of Virginia Midland Railroad between Strasburg and Riverton through the Massanutton Mountain to New Market, thence via Brock's Gap to the West Virginia line, with authority to construct branches of any gauge up to 50 miles in length.

James River & Blackwater Railroad and Lumber Company, incorporated with power to construct a traffic railway from near Proctor's bridge, of Blackwater River, Isle of Wight County, to James River, at or near Burwell's Bay, with branches of 20 miles.

Farmville & Staunton River Railroad Company, incorporated to construct a railroad from Farmville, by or near Hampden Sidney College and through Charlotte County to Staunton River at or below Brookneal.

CONTRACTS LET.

Elevator Contract Let.—Messrs. McIntosh & McInnes, of Halifax, N. S., have received intimation that their tender for the erection of an elevator at the Intercolonial Railway terminus at West's Wharf for about $19,000 has been accepted. Rhodes & Curry, of Amherst, have the trestle-work at about $22,000, and Corston the shed and wharf at $14,000.

Contracts for Iron Roofs Let.—A Washington note of the 12th says: Bids were opened to-day in Supervising Architect Hill's office for iron roofs for the public building at Topeka, Kansas. The contract will be awarded to the Missouri Bridge and Iron Works. Their bid was $21,080.

Government Contracts Let.—Contracts for supplying hardware to the Treasury Department for the next fiscal year have been awarded to E. J. Brooks & Co. and A. Hammacher, of New York, and Frank P. Mary & Co., James B. Lambie, and Joseph L. Savage, of Washington, D. C., and for fuel to George Crevelling and John Miller, of Washington, D. C.

BUILDINGS.

Building Operations in Paris are reported to have assumed enormous proportions. The new buildings are of an expensive character.

The House bill providing for the erection of a public building at Brooklyn, which passed the Senate to-day, is the bill reported to the House in February last by Representative J. Hyatt Smith, from the Committee on Public Buildings and Grounds, and which passed the House on June 5. The bill as it passed both houses of Congress authorizes the purchase of as it eand erection of a suitable building, with fire-proof vaults, for the accommodation of the Post Office, internal revenue offices, and other Government offices, at a cost, for site and building complete, not to exceed $800,000.

The Texas State-House.—Bids for the building of the new Texas State-house were received at the office of Taylor, Babcock & Co., yesterday, and examined by Hon. C. B. Farwell and other members of the syndicate. About a dozen propositions were received from architects at Austin, Tex., St. Louis, Chicago, and Boston, most of them being backed by responsible capitalists. None of the bids were satisfactory in regard to the foundations and preliminary stages of the work and none was accepted. The gentlemen interested thought the work could be done cheaper than any of the bidders' submitted propositions, and they decided to take it in hand themselves. The bids for portions of the edifice were more satisfactory and will be held in abeyance for some time. Col. Abner Taylor stated to a reporter for *The Times*, last night, that the syndicate would probably carry on the work for a year, when they would advertise for new bids to complete the edifice.

School Building in Washington.—Congress has appropriated $9,600 for erecting three new school buildings in the district. The law requires that the contracts shall be made before Sept. 1 next.

Bids Wanted for School-Houses.—Northampton, Mass., wants bids for two new brick school-houses.

LABOR.

The granite trade in Denver, Col., is very dull, there being only about twelve granite cutters employed in that city at present cutting flagging, but the soft stone trade seems to be booming. It is said there are about 250 stonecutters in Denver, almost all of whom are working on the stone work of large buildings and by large contractors, and over 200 of whom belong to the stonecutters' association. They demanded $4 per day and eight hours, which were granted by the employers. A committee of five met the employers, and the matter was amicably adjusted without a strike. One employer said to a reporter: "The men are not pushed as they are in some cities, but allowed to move along at a good honest rate, as their inclination leads them. They are treated like gentlemen. I never saw a more liberal lot of bosses in my life. Wages are steady at $4, and there has been no talk of cutting them down. In some places the bosses are always conspiring to reduce wages every chance they get."—*Granite-Cutters' Journal.*

There are 16,000 men in Florida now engaged in railroad building, such as grading and track-laying.

BRIDGES.

New Bridge.—An iron railroad bridge to cost $12,000 has been commenced at Three Rivers, Mich.

The covered wooden bridge over the highway at Ellis station, 14 miles from Boston on the New York & New England Railroad, was burned on the 11th. Loss between $3,000 and $4,000.

The Commissioners of Middletown, O., have at last concluded to repair the river bridge. An iron span 180 ft. long will be attached to the wooden structure, and the work begun at once. Mr. James Cunningham has the contract for the stone work.

MISCELLANEOUS.

Two hundred thousand dollars were paid for the Allentown, Pa., rolling-mill, which was recently sold at auction.

Letters-patent have been issued incorporating Redmond Brough, civil engineer; Henry O'Brien, barrister-at-law; Thomas Dill, mechanical engineer; Wm. A. Brown, civil engineer, and Robt. Roddy, clerk of the corporation of Toronto, all of the city of Toronto, for the purpose of acquiring and working patents for improvements in railway rails, plant, and supply, and for the construction and manufacture of such rails, plant, and supplies throughout the Dominion of Canada, by the name of the "Canadian Patent Rail Joint Supply Co.," with a capital stock of $20,000.

A SUMMER'S DAY ON THE LEHIGH.

If, wearied with the monotonous tramp, tramp on the piazzas at Nantasket Beach, Coney Island, Long Branch or Atlantic City, the glare of sunlight on tha sandy beach, the blare of the bands, or the constantly iterated cornet nuisance, and the myriad of "sights," ona wishes to enjoy a totally different change of scene and surroundings, we advise him to taka an excursion up the beautiful Lehigh Valley. We have tried it, and speak from what we do know and have seen.

The Lehigh Valley R. R. has its eastern terminus at Perth Amboy, N. J.; but it runs express trains out of New York over the Pennsylvania R. R. track to Metuchen, whence it runs on its own track through the richest and most fertile portion of New Jersey, crossing the Delaware River into Pennsylvania at Easton, and thence running through the best coal and iron districts of the Lehigh Valley to Wilkesbarre and on to connect with the trunk lines west at Buffalo and Suspension Bridge. Its branches ramify throughout the mountains of the Lehigh and Wyoming districts, and on its double tracks a constant succession of long coal and ore trains are going and returning, to and from the seaboard, and the numerous furnaces along the line of route. It is one of the best built railroads in the country, is laid from end to end with double line of steel rails of a peculiar pattern the design of its very able and efficient Superintendent and Engineer, Robert H. Sayre, who has spent all of his business career upon the road, passing through all tha gradations from chainman of a surveying party to his present position; the roadbed is thoroughly ballasted and well maintained, the bridges have been renewed in iron and stone, or are being so as fast as is deemed necessary to safety; anthracite coal only is used, ensuring a mini. mum of cinder and smoka from tha engines; the road traverses one of the most romantic regions in America, and whether in early spring, midsummer, or in the beautiful autumn, the scenery is of surpassing beauty and interest, and the route must grow in popularity with tourists and the travelling public generally.

Several trains leave daily from the Pennsylvania R. R. depot, Jersey City, Courtlandt street ferry. We went cut in one a few days ago, and after a few hours' ride were at Bethlehem, Pa., where we met with a most cordial reception from friend Merriman, Professor of Civil Engineering in Lehigh University, the generous hospitality of whose pleasant home "unter der linden" in this quaint old Moravian town, we enjoyed as only a denizen of this over-heated, baked city can enjoy such perfect quiet, cool shade, and interesting conversation as was here to be found. A hammock under broad branching trees, a fragrant Havana, and a desultory talk about books, civil engineering, the town and its people, the iron and coal trade, and a variety of similar subjects, made time pass rapidly and agreeably, to the utter oblivion of the heated atmosphere from which we had escaped a faw hours previous.

As early as 6.30 next morning, accompanied by the Professor, we were en route for Mauch Chunk. Through Allentown, where the great mills were closed down and idle, Furnace, Catasauqua, Hokendauqua, each with its furnaces in full blast, and through several other busy villages engaged in the iron or slate industries, and Packerton, the busy car-shop town of the road, we rapidly passed, arriving by 8 o'clock at our destination, Mauch Chunk, the "Switzerland of America," as it is called by its special admirers; the county seat of Carbon County, Pa., 120 miles from New York, and 89 miles from Philadelphia.

The Indian name of Mauch Chunk is "Machk Tschunk," or Bear Mountain, from which it derives its name. "*Picturesque America*" says "Mauch Chunk is doubtless the most truly picturesque town in the Union; it lies in a narrow gorge between and among high hills, its foot as it were resting on the picturesque little Lehigh river, and its body stretching up the cliffs of the mountains: it is so compact among the hills that its houses impinge upon its ona narrow street, and stand backed up against the rising ground, with no space for gardens, except what the owners can manage to snatch from the hillside above their heads." This is true, and furthermore, as to the soil of the gardens, it looks as if it all had to be carried there on the backs of the owners of the little patches, since all around is only bare rock debris forming the mountain back of the town.

The town itself owes its origin to the enterprise of the Lehigh Coal and Navigation Company, who started the settlement in 1818; the population now is about eight thousand. The principal hotels are the Mansion House and American Hotel; we stopped at the formar in 1879, and at the latter on this trip; we think the money was very much better invested at the former.

MAUCH CHUNK.

The SWITCH BACK is the great attraction of Mauch Chunk, as by means of it the magnificent scenery and bracing atmosphere of the vicinity are enjoyed. It was formerly a switch-back or zig-zag railway up the mountain side for coal-carrying purposes; but it is now simply a "gravity" railroad, the car running down the inclines by its own weight overcoming the friction, to be hauled up at eithar end to the mountain top. The road is used only as a pleasure road. It belongs to the Central R. R. of Naw Jersey, and is leased to Theo. L. Mumford, who, with his brother, H. J. Mumford, Superintendent, and Thos. S. Grimwood, Secretary, 51 Chambers street, New York, constitute the entire executive department of the road. Its official name is the Mauch Chunk, Summit Hill & Switch Back R. R. Trains, consisting of one open car about the size of the ordinary open horse-car, leave the station of Upper Mauch Chunk six times every week day and eight times on Sundays, between 8:30 a. m. and 5:15 p. m. To reach the point of departure it is easier to go afoot from the depot across the bridge and up the single street to the top of the hill, a journey of say ten minutes, which by stage occupies nearly half an hour and is much more fatiguing. A small station furnishes a waiting-room for passengers. The car soon makes its appearance, in charge of Mr. H. J. Mumford, a very pleasant and genial young gentleman, whose principal business in life during the tourist season seems to be to add to the gratification of the continually increasing patronage of his unique road by unvarying courtesy to all. The alignment of the road and its construction may be considered a very fine engineering feat, when we consider the early date of it. We did not find out the name of the chief engineer under whom it was built; but probably it is familiar to many of the older engineers of the country. An engineer was sent to England to see the method of construction and operating of similar roads in the mining regions there. Upon his return a short section of sample track was built. The engineer had forgotten to note the working of the switches, and had to be sent back to England to repair the oversight, a matter of several months' delay in those days of sailing vessels only. The first line of gravity road was finally completed in 1819, and the second, or back track, in 1844. It starts from the foot of Mt. Pisgah, thence to the top. The following is a table of distances and grades:

Length of Mount Pisgah	2,322	ft.
Height of Mount Pisgah	664	"
Distance from Mount Pisgah to Mount Jefferson	6¼	mls
Fall from Mount Pisgah to Mount Jefferson	302	ft.
Length of Mount Jefferson	2,070	"
Height of Mount Jefferson	462	"
Distance from Mount Jefferson to Summit Hill	1	mi.
Fall from Mount Jefferson to Summit Hill	45	ft.
Grade from Summit Hill to Mauch Chunk, to the mile	96	"
Summit Hill above the Lehigh	1,015	"
Mount Pisgah above the Lehigh	900	"
Mount Pisgah above the tide	1,500	"
Mount Jefferson above the tide	1,660	"
Distance from Mauch Chunk to Summit Hill and return	18	mls. circuit.

There are two tracks; tha open car runs on to the left track going up, over a depressed track at the foot of the incline; when in position, the signal for steam is given, and a safety car is hauled to the rear of the other from the bottom of the depression, while a counterpoise in the shape of another safety car commences the descent on the right track. Two heavy Swedish iron bands, each seven and one-half inches wide, and about three-sixteenths thick, double spliced and riveted, are attached to the safety cars. These bands are fastened to iron drums, twenty-eight (28) feet in diameter, in the engine house at the head of the plane; the motive power being two stationary engines of one hundred and twenty horse power each, while the steam is generated in ten boilers, which measure 2½ x 30 ft.

The safety car has attached to it an iron arm, which extends from the side of the "Barney" or safety car, over a ratchet rail between two tracks; should the band break, or any accident happen to the machinery, the least backward movement causes the arm to drop into the notches of the safety rail, holding the train stationary.

The bands have been in use 34 years; they show very little signs of wear; there has never been an accident on the road, and with reasonable watchfulness there ought not to be any. The safety arrangement on the Mount Jefferson plane consists of a stout iron bar slung at the side of the safety car, which by the least backward motion is let down automatically, and being forced into the roadway stops the downward progress of the car. It is difficult to determina what would be the action of these safety appliances in case of accident, and it is to be hoped there will be no occasion to test them.

Tha trip over the road is an exhilarating one from first to last. The air is most invigorating, the scenery that of a mountainous region; at this season of the year the air is sweetly perfumed by the fragrance of wild grape blossoms; the car speeds swiftly along without jar or dirt or smoke; a considerable portion of the whole route is in curve; the feeling of nervousness soon wears off, and the excitement and novelty of the ride is thoroughly enjoyed. At the foot of the incline the car is hauled to the top of Mount Jefferson, and the return trip begins by running slowly to Summit Hill, a forlorn and ancient mining town, where a stop of twenty minutes is made to allow a visit to the burning mine close by. The "burning mine" is a humbug; the region is desolation itself, and a walk through the deserted street makes one feel sad to think of the little that is left to the hard-working, barren lives of a mining population. This Summit Hill is quite a famous place, as it was here that anthracite coal was first discovered in 1791, by a hunter named Philip Ginter, who, however, realized but little substantial benefit from his discovery. The town was a center of Molly Maguireism a few years ago, and has nothing now to recommend it as a place of residence. Three years ago, in company with a professor of Wisconsin University, after a walk across the country from Delaware Water Gap, we wandered about over this desolate region for half a day in a pelting rain, and pretty thoroughly explored the length and breadth of the "burning mine," visited the "ice cave," a deep hole where sufficient heat from the sun to melt the ice fails to penetrate its depths—to the benefit of a poor woman who picks up a few quarters by showing the passage into it—then over the great mountains of coal débris from the former open mining process and which is the best monument of the enormous amount of manual labor that has been expended in this region, but from all which so very little benefit has clung to the laborers. Down in the valley we came, drenched to the skin, to the huge coal breaker where, enveloped in blackest dirt, sat hundreds of boys and men from twelve years up, sorting "black diamonds" from which their small moiety sufficed only to keep soul and body together from day to day, with scarcely a cessation of hardest toil throughout their miserable lives. We think that a mining region is the most God-forsaken portion of civilized communities, and in no other is humanity driven more closely to the very verge of existence only.

The ride from Summit Hill, which place one is only too glad to get away from, is even more exciting and invigorating than that to it, as the car speeds along more rapidly, reaching even a mile per minute for about three miles, and the trip is considered only too short when the station at Mauch Chunk is once more reached.

Immediately after the trip over the Switch Back there is just time to catch the train for Glen Onoko a few miles west of Mauch Chunk. This delightful gorge in the mountains belongs to the Lehigh Valley Railroad Company, and during the past year the company has expended a large amount of money in the construction of a path to the top, in improving the grounds at the station, and in the erection of buildings to accommodate pleasure seekers. The officers of the road most especially interested in developing the beauties and attractions of the Glen were: Mr. Jas. I. Blakeslee, a resident Director; A. G. Brodhead, Jr., Superintendent of the Beaver Meadow Division; Mr. Wm. B. Mack, Road Master, and Mr. E. B. Byington, the enterprising General Passenger Agent of the company, and they certainly have succeeded. Nearly three hours can be spent here very agreeably in climbing up the Glen, resting at the cascades on the way, and completing the ascent at Packer's Point, from which one of the most extensive and charming landscapes in America is visible. There is some little historical interest also attached to the place, as in the ascent, about 900 feet above the Lehigh, the old Warrior Path, used as a trail by the Indians in passing from the Susquehanna to the Delaware, is met, and it was through here also that General Sullivan and his army passed after the Wyoming Massacre in 1778.

The train returns from the Glen in time for the tourist to get his dinner and a train for New York if he wishes it. We wished it and at 8 p.m. we were again in Bethlehem, and under the efficient guidance of Professor Merriman were soon interviewing the deserted class-rooms, the museum, library, and beautiful campus of the Lehigh University. On our return from Mauch Chunk as in going thither, we did not fail to notice the great hills of slag from the furnaces which for years have been piling up until at last the matter is becoming a serious one on account of the encroachments on the water way of the river and effects of the embankments in times of freshets. If nature had only deposited these ore beds near the Mississippi, they would have made material for levees that would have defied the floods and the gophers. At Bethlehem the slag from a zinc works, which for years has been accumulating, has been found so rich in manganese by recent experiments that now a company has erected a furnace and are working the pile of debris for the spiegeleisen which they extract from it, and for which they find a ready sale at their own doors. Will the time ever come when some chemical genius will discover such merits in a slag pile as will introduce a new industry and relieve the embarassments of the furnace proprietors in their demands for dumping grounds?

Mount Pisgah Plane.

Lehigh University is located in South Bethlehem, Pa., at the base of the Lehigh mountains, and seven hundred feet back from Packer avenue. It is the gift of the Hon. Asa Packer, of Mauch Chunk, the projector, builder and principal owner of the Lehigh Valley Railroad, who originally appropriated $500,000 to erect buildings and commence the classes, and who at his death left an additional $2,000,000 to endow it and the library connected with it. It was incorporated by the Pennsylvania Legislature in 1866. The original object of its founder was "to afford the young men of the Lehigh Valley a complete technical education for those professions which had developed the peculiar resources of the surrounding region. Instruction was to be liberally provided in civil, mechanical and mining engineering, chemistry, metallurgy, and in all needful collateral studies. French and German were made important elements in the collegiate course. A school of general literature was part of the original plan, together with tuition in the ancient classics. The Institution was freely opened to pupils from every part of the country and the world." The tuition is *free* in all branches and classes, and the cost of attendance for room rent, board, books, etc., for 40 weeks varies from $240 to $375. It is essentially a school of technology of which the first course is civil engineering. From the *Register* we extract the following relating to this course:

"The general scope comprises the higher branches of the applied mechanics and mathematics, together with the principles of construction and exercises in mapping, drawing and designing. The student is made acquainted with the strength of materials, including the theory of elasticity or flexure, the principles of construction of roof-trusses, beams, girders and bridges, the determination of their proper dimensions and the preparation of working drawings. Under this head belong also the theory of the stability of structures, including the theory of the arch and of retaining walls; the principal of hydrostatics and hydraulics with their applications to vertical water wheels and turbines. The theoretical principles are in all cases illustrated by examples from actual engineering practice. Much time is devoted to surveying operations and to actual practice in the field. Profiles, plans of topographical surveys, contour maps, and railroad charts, are made. The practical operations connected with the reconnaissance, location and survey of roads, canals and railroads, are fully illustrated in the field. Thorough instruction is given in drawing, the construction of working drawings of structures, topography and hydrographical charts.

"Attention is also paid to the application of the general principles of the science of engineering, or to engineering construction, including the composition and qualities of materials: their dressing and preservation; foundations, earth and rock-work; the drainage, collection and distribution of waetr. Visits of inspection to engineering structures in the Lehigh Valley and vicinity are regularly made. So much of mechanical engineering is necessarily included, as refers to the construction of bridges, and the special machinery and appliances used in the erection of structures. There is also thorough instruction in mineralogy and geology. The course in astronomy in the Senior year includes practical work in the observatory.

"Designs for and reviews of special structures, specifications and estimates of quantities and cost, and the preparation of a graduation Thesis giving evidence of satisfactory attainmente, complete the course of study.

"The graduate in this course will receive the degree of Civil Engineer. (C. E.)"

In looking over the class register from 1869 to 1881 we find the names of many men already eminent in the professions and especially in engineering, and the extent and importance of their occupations is most flattering to the institution and very encouraging to its graduates. This register of civil engineering classes, like that of other similar institutions, is good reading for the profession, as it is a pretty accurate record of the results of a scientific training in the excellent schools that are now in good progress throughout the union.

There are some peculiar advantages accruing to the graduates of Lehigh University. The institution is a Lehigh Valley R. R. favorite on account of its association with the memory of their mutual projector, and graduates who possess a fair modicum of ability readily find situations on that line, where they obtain the benefit of actual practice in field and office, and go out into the world ready for actual service, with the cobwebs of scholastic vanity tolerably well brushed away by their supplementary course of training. The region is one full of interest and instruction to the student of civil, mining, or mechanical engineering and chemistry, and on the line from Easton to Wilkesbarre, he is in constant practical intercourse with nearly every department of these professions. The whole valley is a hive of engineering industries, and he would be a dull student indeed who would not absorb some of the influences that meet him at every turn throughout his years of study. The faculty are wide awake men, appreciating the spirit of the founder of their college, and to their talent as instructors they add the most earnest encouragement to their students to use the advantages they possess. The institution is growing, and with its liberal endowment, and encouragement of powerful patrons, it must within a decade or two hence rank among the leading educational institutions in the Union. Special provision for the convenience and comfort of the engineering classes is made, and young men contemplating adopting this profession should not neglect to learn of its advantages before choosing where to go. Among the theses read at the last commencement we note the following:

The Preliminary Survey, Profile, and Earthwork Calculations for a Proposed Railroad in Northampton County, Pa., by Elmer Henry Lawall. The Reconnaissance, Map and Estimate of Cost for a Proposed Railroad in Northampton Co., Pa., by Robert Thomas Morrow, J. Review of the Brooklyn Anchorage of the East River Bridge, by Eugene Ricksecker. Plan and Estimate of Cost of a Proposed Water Supply for the Borough of Montrose, Pa., by Samuel Brenton Sickler.

A few miles from Bethlehem, is Easton, the seat of Lafayette College, an institution chartered in 1826 and which is mainly devoted to the religious training of its students. Its main building, however, is the gift of Mr. Ario Pardee of Hazleton, a wealthy coal operator, and according to the college register "was erected and equipped for the uses of the scientific department" at a cost of nearly $300,000. The best part of the new building is occupied with the usual rubbish of a "museum" which apparently is the regulation advertising dodge of every well regulated collegiate institution. The class in civil engineering has been sent, as is usual in railway offices, to the top floor, and when we had climbed the long flights of stairs to its two small rooms we found that Prof. Fox was having a hole cut in the roof of the building to let out the hot air that was almost unendurable. The theological spirit in command is too rampant to harmonize with practical science at Lafayette, and it is very evident that the civil engineer, who to-day opens up to civilization and christianity thousands of humanity, where the average missionary does one person, must back down and out of Pardee Hall—or roast. Prof. Drown, the well-known and very able Secretary of the American Institute of Mining Engineers, has already been roasted out, and his resignation is in the hands of the faculty, while he is in Europe. A blank line takes the place of his name in the list of professors.

Are there too many young men going into the engineering profession? This is a very natural question to ask after looking over the annual registers of a goodly number of colleges that are now entirely or nearly so, or which have only a department, devoted to special scientific training. We do not think there are. The instruction imparted is severely practical, and cannot fail to prepare a young man, if he have ordinary common sense, to make his way in the world with more success and more genuine satisfaction than if he had not the training. The whole world is now an open field of competition for the best men, and the records of our engineering classes bear good testimony to the value of the special preparation they have had. The world is being made better and more comfortable to live in every day by the quiet, persevering and scarcely appreciated labors of engineers and chemists, and in the problems that are to be solved, where the great forces of nature, and the present waste through ignorance, are to be further utilized, the graduates of our scientific schools and college will be the men whose brains and hands will serve their fellow men to good purpose. Concerning the pecuniary encouragement for engineer graduates in America, they are better off than the members of other professions. A young doctor has a good chance for personal experiment on the "blues" before a paying patient solicits his services; a lawyer performs years of office drudgery before profitable clients seek his service, and ministers grow gray "in the itinerancy" before they sit on the soft cushions and inhale the piled-up fragrance of a city church; the young engineer graduate almost always gets speedy employment at good pay for a beginner, and for a few years can snap his fingers at the lawyer, the doctor, or the parson, who were fellow graduates of the same year. But about the time $1,500 or $2,500 are reached, so is the zenith of many of them, and possibly while they are still spoiling their eyes squinting through a transit or a level on a railroad, the other men will have passed them and be in the enjoyment of good fat fees and salaries, to say nothing of Congress and professorships. There are engineers who for specialties get larger salaries and occasionally become wealthy; they are not "as the sands of the sea for number," however, and as compared with successes in trade are in small proportion. The salaries of good American engineers are as yet far too insignificant as compared with the value of their services, but how they are to be raised is a problem too difficult for us to solve. On principle, we always advise engineers to go into other branches of business; we think they are better fitted for some kinds of business than most of men, and their absence leaves a better field for those who remain.

The "great man" of the Lehigh Valley was Asa Packer, who died May 17, 1879. He was born in Connecticut 77 years ago, and his life from early boyhood was one of unvarying industry and close economy. He was of too enterprising a disposition to be a New England farmer, or to remain a lifetime as a simple mechanic, content with the small wages that daily manual labor earns. Like the popular candidates for the Presidency of this great Republic, Mr. Packer graduated from the tannery and canal boat, and as a carpenter he came so near to rail-spliting that it is strange his claims were overlooked. But from building, repairing and "running" canal boats he "grew" naturally into the coal trade, and with its growth he soon found himself on the direct route to wealth. With money in hand and the brain to comprehend the possibilities of the future, Mr. Packer bought up the then low-priced stock of the Lehigh Valley Railroad, and by his personal energy and perseverance built the road, and in doing so accumulated a vast fortune through the enhanced value of its stock, as a payment for his labor, intelligence and administrative skill. The grand enterprise of his life was this great railway; he had no irons in other fires; he never speculated (so it is said) in margins, but remained all through life the same industrious, hard-working, honest, money-making and saving man that he was when he turned his back on the slow moving plough in favor of the "swifter" canal boat. He, probably more than any other one man, developed the industries of the Lehigh Valley, and he has left behind him monuments that will keep the memory of his life and labor forever green amid the scenes of his long and useful career.

On our return from Bethlehem we stopped off at Glendon to interview Mr. Frank Firmstone, the always-hard-at-work Superintendent of the furnaces at that place, about an extraordinary blast which had been exploded at the Glendon Company's quarry shortly before. Mr. Firmstone hadn't anything particular to say; he used 28,000 lbs. of Judson powder, but he was quite confident that 18,000 lbs. would have been quite as effective; he drove a tunnel under the hill of stone some 40 ft., and ran cross chambers from it; the face of the quarry was 170 ft. high above the chambers, 140 ft. in length, and the breast 46 ft. thick; the powder was rammed in four sections with exploders in each, and all connected, the main lines running to a magnetic battery a couple of hundred feet distant. This brand of powder, although well known on the Pacific Slope, has not heretofore been used in the big blasts in the East, and its efficiency was to be tested by this blast. It stood the test very successfully and brought down, it is estimated, over 100,000 tons of stone; Mr. Firmstone said he could not estimate it, hadn't time, but there was probably a two years' supply for the furnaces. He thought the powder exhibited excellent qualities as an explosive; he had never used it before; but was well satisfied with the results of his first trial of it. From further inquiries we learn that the Judson Powder is composed principally of nitrate of soda, bituminous coal and sulphur, with a small quantity of nitro-glycerine admixed. The ingredients are ground dry and separately, then mixed in a heated state, and incorporated with a non-absorbent adhesive material, which has the effect of keeping out moisture, and also preventing the nitro-glycerine from being absorbed; it thus allows of a less quantity of the nitro-glycerine being used than in a high explosive, and a consequent cheapness in price. The Judson Powder is manufactured at Drakesville, N. J.; there are three grades called R. R. P., or common Judson Powder, F., and F. F. The R. R. P. is intended to be used as a substitute for black powder, and its efficiency in hard rock is as 1 to 1⅓ of black powder, and in seamy ground, such as slate, sand-stone, hard-pan, clay, and in all kinds of earth blasting where it is impossible to confine black powder long enough for it to develop its full strength, then one pound of Judson powder will, it is claimed, do the work of two pounds of black powder. The explanation of this is: in ordinary gunpowder the process of ignition is gradual from the outside of the grains toward the centre, and from grain to grain it is cumulative; it concentrates itself in the line of least resistance, and its power is never greater upon any other part of the containing body than upon that which yields, or, in other words, it can never be greater than the resistance of the least resistant part. In the case of the Judson powder, like all other powder containing nitro-glycerine as the detonating agent, it develops its force with great rapidity; the nitro-glycerine, which is distributed throughout the mass of the dry mixture, will, when exploded with a strong fulminating cap detonate in every particle of nitro-glycerine throughout the charge, and the instantaneous explosion of the nitro-glycerine will in turn ignite every particle of the dry mixture and convert them into gas. For railroad and quarry work the Judson powder is claimed to be the best in the market, if used by an intelligent blaster, and great saving can be made, not only in reducing the number of holes to be drilled, but also in the quantity of powder to be used. The comparative cost of No. 2 Giant powder and Judson powder is estimated at 38 cents to 24 cents per cubic foot of rock removed. We understand that Judson powder is now being used with great success on the heavy rock work of the West Shore Railroad, and on several other contracts in this vicinity.

A CAST-IRON pipe foundry is not a pleasant place to visit on a hot day, but being in the neighborhood we made a call on the secretary of the Warren Foundry and Machine Co., at Phillipsburg, N. J., just over the river at Easton, Pa., and spent a sweltering hour in watching the process of pipe making from running the moulds to testing and shipping the completed product. The works cover a considerable area; there are 14 pits in all, in which pipe from 2 to 48 inches diameter are cast; there were 800 men at work and orders from a large number of water and gas works were being filled as rapidly as possible. We were conducted through the works by the very obliging superintendent, who, so he informed us, while in the straw rope making shop, where the first work on the cores is done, commenced his service in that very shop and so had passed through all the grades to his present position. The day was one of the hottest of the season and we may well be excused for not loitering unnecessarily about the hot castings and glowing ladles of melted iron which were being slung about so unconcernedly and easily by a score of cranes handled by the half-naked muscular employees. The officers of the company are Daniel Runkle, president and treasurer; William R. Wilson, secretary; John Ingham, superintendent. New York offices of the company are at 160 Broadway, William Runkle, agent. At 7 p. m. we were back in the city after the home ride through the rich grain fields of New Jersey.

ENGINEERING NEWS
AND
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GEO. H. FROST.......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, JULY 22, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.

COLORADO MEETING.

Programme.

Saturday, Aug. 19—In Denver. A brief preliminary evening meeting, at which the Institute will be received by the citizens of Denver.

Monday, Aug. 21—Visit to Black Hawk and Central, with an evening session at Central City.

Tuesday, Aug. 22—Georgetown, Idaho Springs. Return to Denver in the evening.

Wednesday, Aug. 23—Leadville, going over the South Park Railroad. Evening session.

Thursday, Aug. 24—Excursions to the Leadville mines.

Friday, Aug. 25—Excursions to the Leadville smelting works, reaching Pueblo at night.

Saturday, Aug. 26—Pueblo Iron and Steel Works, and Mather & Geist's Smelting Works. Colorado Springs and Manitou in the evening.

Sunday, Aug. 27—Colorado Springs and Manitou.

Monday, Aug. 28—Return to Denver. Evening reception.

Tuesday, Aug. 29—Argo Smelting Works. Golden and its smelting works. Subscription dinner.

Besides these excursions, facilities will be afforded those who desire to see the iron and coal mines of Colorado. And for those who can extend their visit, an excursion to the San Juan district will be organized.

Arrangements are being made with the railroad companies for reduced rates to members of the Institute and ladies accompanying them. When concluded, a circular will be issued informing members of the expenses from different points to Denver and return. These rates will probably not exceed two-thirds the regular rates, or about $60, plus Pullman car special rates, from New York to Denver and return. Special facilities are courteously offered by the roads to Colorado for the excursions of the Institute.

Persons proposed for membership have the same privileges as members with regard to the meeting and excursions.

As usual at the meetings of the Institute, ladies are expected to be present. Seventy-seven members with forty-three ladies have already signified their intention of being present at the Colorado Meeting, and it is expected that the attendance will greatly exceed these numbers.

The unusual attractions offered by the mining regions of Colorado are increased at this time by those of the Denver Exposition of mining appliances, minerals, etc., and by the unusual facilities offered for examining mines and works, and acquiring information concerning them.

The representatives of several foreign kindred societies are expected to be present.

Members who purpose attending this most interesting meeting should at once write the secretary of the Institute, who has to notify the railroad companies of the number of tickets required, and the names of those entitled to the special rates offered. They are also requested to inform the secretary promptly of their intention to read papers at the meeting.

Prof. W. I. Marshall, who is well known by his lectures on the wonders of the Geyser Country, offers to conduct a party of not less than eight, nor more than twenty-five, through the Yellowstone National Park. This trip would occupy from twenty-six to twenty-nine days from Denver to and through the Park and back to Denver. The greatee part of this time would be spent "camping out" in the Park. The expenses of this round trip are estimated at from $275 to $300 for each person. Full information concerning this trip may be obtained from Prof. W. I. Marshall, Fitchburg, Mass.

R. P. ROTHWELL, President,
27 Park Place, New York City.
T. M. DROWN, Secretary.
Easton, Penn.

A RAINFALL of 1.28 inches occurred at Boston on the 19th.

DR. TAYLOR has reported to the Philadelphia Board of Health, through the Sanitary Committee, the result of the analysis recently made of the waters of the Schuylkill River. The result of the investigation shows that the fears of the river having been poisoned are unfounded, and that the phenomena observed in the waters in the vicinity of Reading are by no means unprecedented.

THE SUBURBAN RAPID TRANSIT RAILROAD COMPANY will begin the construction of their bridge across the Harlem River, this city, at the end of Second Avenue, immediately. This road connects with the Second and Third Avenue elevated railroads at One Hundred and Twenty-ninth street, and after crossing the river, traverses the twenty-third and twenty-fourth wards. The plans for the bridge have been prepared under the direction of J. James R. Croes, C. E., the engineer of the company; the details of the superstructure will be after the designs of Theodore Cooper, the well-known bridge engineer. The draw will be 250 feet long, with two side spans of 94 feet each. As the law requires the bridge to be built at right angles to the stream, and at least 24 feet above high tide the north end will be on the land of the Harlem River & Port Chester Railroad, now used as depot grounds, over which the road will pass by an elevated structure.

HELL GATE.

The navigation of Hell Gate and the East River was impeded and rendered dangerous by the presence of large rocky obstructions, located at varying depths below the surface. These formations, in conjunction with strong currents, which always threatened, and sometimes did, hurl vessels upon the reefs, made the passage extremely hazardous for medium-sized boats, and precluded the passage of large ocean steamships. As given in the report of Gen. John Newton, for the year 1881, to the Chief of Engineers, U. S. A., the depth over Diamond Reef, at mean low water, was 17½ ft.; over Coenties Reef, 14.3 ft.; over Frying Pan, 11 ft.; over Pot Rock, 20 ft.; over Heel Tap, 12.1 ft.; over the reef at the North Brother, 16 ft. Hallet's Point extended from the shore at Astoria for 325 ft. to the contour line of 26 feet at mean low water, and had an area of about three acres. This was tunneled, and the explosion took place in 1876, since which time dredging operations have been carried on to remove the broken rock to the requisite depth. The Middle Reef—otherwise known as Flood Rock—had an area of about 9 acres and was situated directly in the channels at Hell Gate; a small ridge projected above the water and upon this vessels were thrown by the powerful ebb currents in whose path it lay. Further on we shall describe the operations now being carried forward at this point. In regard to the disasters here occurring the report says: "Hallet's Point and the Middle Reef may be said to have been alternate in mischievous functions; vessels which escaped one ran a great risk of falling upon the other. What added considerably to the danger from these reefs was the bend at right angles of the river at the spot."

Work was continued during the year at Flood Rock until last Wednesday (the time of our visit) when it became necessary, owing to the delay in Congress of the River and Harbor appropriation bill, to suspend the men until its passage. The expense of a complete cessation of work, the removal and care of machinery, in undertakings of such magnitude as this are not known to the public and can only be fully appreciated by those in charge. This expense may in a great measure be considered as thrown away inasmuch as it is caused by the care of plant which is unproductive and yet requires labor for its proper protection. The amount of travel which would pass through the Gate because of the saving in time alone, and the increase which has followed the results already obtained, should be sufficient guarantee of the value of the work in progress and insure money sufficient for its early completion by uninterrupted labor.

The total amount expended to the close of the fiscal year ending June 30, 1880, was $2,359,380. The amount expended during the year ending June 30, 1881, was $256,981, and the amount available for the year ending June 30 last was $307,903, which has been expended in completing the removal of broken rock at Halletts's Point to the depth of 26 ft. M. L. W., removing Heel Tap and the reef at the North Brother, operations on Frying Pan and Pot Rock (described later), and in extending the excavations under Flood Rock. At the date of the report, General Newton placed the estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, at $2,215,078.

FLOOD ROCK.

The work at Flood Rock consisted of excavating a central shaft, and from this opening galleries running at right angles to each other and having a distance of 20 ft. between centres. Supporting columns are left in each square, and these, as the work nears its end, will be reduced as much as possible in size. The excavated material is taken on cars to the shaft, where it is hoisted, and by an automatic dumping car (described in a previous number of ENGINEERING NEWS) is thrown into a chute leading to a scow moored alongside. A new Rand air-compressor has been added to the permanent plant and an 80-horse-power boiler. Also 12 drills of the Rand and Ingersoll companies; three of these are now kept at work drilling holes for the final explosion that will take place in September or October next year. As soon as the work has been trimmed down as much as may be considered safe, all the drills will be put on the charge, and about 125,000 feet of three-inch holes opened.

The following table shows the progress on flood rock for the year ending June 30, 1881:

Linear feet of galleries driven	7,312
Cubic yards of rock removed	18,090
Holes drilled	65,390
Number of blasts	61,586
Number of exploders used	61,595
Feet of fuse used	240,209
Pounds of powder used	46,868
Number of cars hoisted	32,102

The total amount drilled was 269,182 ft. at an average cost of 25.1 cents per linear foot. The average drilling per cubic yard was 14.88 feet; the explosives used per cubic yard being 2.59 pounds.

The total cost per cubic yard for material excavated was $8.98. For the year ending June 30, 1882, there were 31,000 cubic yards removed. The area now tunneled is equal to about 8 acres.

POT ROCK.

A little over one month ago the United States steam-drilling scow was moored over Pot Rock and during that time four blasts have been obtained, the last one being on July 19. The drill consists of a large scow moored securely by six anchors—three from each end—at the end of about 600 feet of one and one-half inch chains. The capstans are worked by double-oscillating engines. A boiler of 150 horse-power furnishes steam to 18 engines. In the hull are located the machine, carpenter and blacksmith shops.

The drill proper consists of a nearly hemispherical dome placed in the center of the vessel. Through the top of the dome are 21 holes, arranged symmetrically, through which the drills pass. On a frame-work over the dome are the engines for operating the drills. These engines are nine in number, but may be shifted so as to be in a vertical line with any of the holes in the dome through which it is designed to operate. The drills are bars of steel from 11 to 12 feet long and weighing about 700 pounds, the hole being about six and and one-half inches in diameter. The engines for working the drills are single acting, the drill being allowed to drop of its own weight a distance of three feet. A spiral slot in the piston rod of the engine gives the drill a movement at each stroke, of about one-eighth of a revolution. The drills will open about 12 feet in five hours work.

There are constantly employed on the scow four divers, two being on duty during the day and two at night. As soon as the holes have been excavated to the requisite depth a diver descends with a tube of tin, which will just fit the hole and is of the same length. This is inserted to prevent filling by sand or loose rock. A string with a float guides him to this hole, which is always the one that will be nearest the scow after it has moved off to be away from the explosion. Like tubes are placed in all the other holes when they are ready for the cartridges. The diver places the first cartridge (made of tin and of a size that will just permit their insertion in the cylinders) in the hole number one, and, guided by a string, proceeds to number two (in the charge fired last Wednesday this was directly to the left of the first hole) thence to the rest of the holes. The strings for the guidance of the diver are rendered necessary on account of the darkness prevailing at the bottom. The holes are charged as described in order to prevent the fouling of the two wires leading from each cartridge to the battery. When everything has been made ready for the blast, the scow is hove off about 175 feet, and the charge fired by electricity. On Wednesday nine holes were fired, there being used 367 pounds of powder. During the time the scow has been working at this point there have been four charges fired, and as the dome is 30 feet in diameter, an area of about 30 by 120 feet has been loosened. In these four charges 1852 pounds of powder were used.

The average cost per lineal foot of hole drilled, including placing of scow, lowering of dome, expenses of drilling, cost of sharpening drills, expenditure of steel, hoisting up of dome after drilling, and heaving off scow was as follows at the places mentioned:

Diamond Reef, 1879-80	$1.22
Heel Tap Rock, 1880	75
North Brother Reef, 1881	67

The time and extent of further operations at Hell Gate will depend upon the River and Harbor bill. Should it fail of an early passage and liberal appropriation, the work in some cases will be liable to injury, and an unremunerative outlay will be going on.

PERSONAL.

MR. J. M. GOODWIN, at Sharpsville, Pa., is chief engineer of the Sharpsville new line.

MR. C. STOWE has been appointed chief engineer in charge of construction on the Fargo Southern.

MR. W. F. GARIS is chief engineer of the Burlington & Ohio River Railroad, with headquarters at Carlinville, Ill.

MR. C. G. WAITE is chief engineer of the Nebraska, Topeka & Memphis Railroad. Headquarters at Girard, Kan.

J. NELSON TUBBS, Chief Engineer, and EMIL KINCHLING, First Assistant Engineer, Rochester, N. Y., Water Works, were in the city on Monday last on business connected with their department.

JOHN H. HARRIS, formerly of the Geo. F. Blake Mfg. Co. and late of the Deane Steam Pump Co., has formed a business connection with the house of Henry R. Worthington, 239 Broadway, where he will be pleased to meet his friends and others interested in steam pumping and hydraulic machinery.

The Secretary of the Treasury has called for the resignation of George B. N. Tower, Supervising Steamboat Inspector of the second (New York) District.

This action of the Secretary is based upon the insubordination of Mr. Tower, who recently ordered two of the local inspectors in his district to disregard a rule of the board of Supervising Inspectors relating to life-saving equipments on passenger steamers. Mr. Tower is the author of a book on bridge building.

RUDOLPH HERING, MEM. A. S. C. E., for many years engineer in charge of sewers in Philadelphia, is rapidly taking position among the leading sanitary engineers of this country. Since severing his official connection with the city engineer's office of Philadelphia, he has met with the most flattering success as consulting engineer for sewerage works. Within a short time past he has been retained by the cities of Cleveland, O.; Appleton, and Racine, Wis., and Waterbury, Conn., to advise in sewerage systems, and he is in correspondence with several smaller cities which have prospered sufficiently to make their inhabitants "hanker" after the conveniencies of improved sanitation. The City of Appleton will probably soon commence the construction of sewers after MR. HERING's plans.

WILLIAM H. COOK was the Surrogate of Philadelphia and a lawyer of good attainments. One day in 1878 he started for Doylestown, Pa., and was seen by numerous acquaintances on the way and at the railroad station. Then he disappeared, and his relatives searched in vain, no trace of him being found. He was given up for dead. But he was alive. A sudden affection of the brain had destroyed his memory of the past, and he could not even recall his name. He wandered about for several years, and at length became a runner for a Newport hotel, where he was known as "General Hill. His feebleness of mind and body, together with his change of manner and dress, prevented any chance recognition. A short time ago he had brain fever, and in his delirium told who he was. He is now back with his family, and slowly regaining his reason; but the five years of lunacy are a blank to him.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 239.)

CCCLVII.—BELVIDERE, N. J.

Belvidere, New Jersey, in lat. 40° 50 N., long. 75° 2 W., is on the Delaware River in a rolling country. The date of its settlement is not known.

Water-works were built by a private company in 1878 after plans of J. A. Cloud, taking the supply from the Delaware River, and pumping it 150 ft. by a Blake pump of 500,000 gallons daily capacity, into a stand pipe 8 feet in diameter and 130 feet high.

Distribution is by 3½ miles of cast-iron pipe of 8 in., 6 in. and 4 in. diameter with 30 fire hydrants, 10 gates and 80 taps.

The population in 1880 was 2,600. The consumption is not known.

The works cost $65,000. The bonded debt is $50,000. No further statistics are furnished.

CCCLVIII.—PALESTINE.

Palestine, Texas, in lat. 31° 45 N., long. 95° 33' W., is on a ridge. The nearest stream is Trinity River, 6 miles distant. It was settled in 1830, but had very few inhabitants until the construction of a railroad through it in 1876.

Water-works were built in 1882 by Carroll E. Gray for a private company. The supply is taken from 97 springs in two valleys, respectively, a mile and half a mile long, and from 60 to 100 ft. deep. The spring issues from the outcrop of a stratum of fine white sand, which underlies from 8 to 10 ft. of clay along the base of the hills. The springs were enclosed with wooden curbs and lined with brick in cement, and covered with trap doors. Their overflow is collected by earthenware pipes, beginning with 3-in. and increasing to 12-in., as they go down the valley intercepting the several springs. The water is collected in a tight brick well, 65 ft. in diameter and 30 ft. deep, and is then pumped into the mains and a stand pipe. The steam pipes, two in number, were constructed after the designs of W. E. Worthen, C. E.

The stand pipe, 3,500 feet from the works, and on ground 90 ft. above them, and 35 ft. above the town, is of plate iron, 2 ft. in diameter and 150 ft. high. It is supported by 8 wire rope guy rods with turn buckles, four of them attached to the pipe 80 ft. above the ground, and four at the top.

Distribution is by 6 miles of cast-iron pipe of from 12 to 6-in. diameter, with 35 fire hydrants. The town pays $100 each per annum for 25, and the railroad company pays for 10. Service pipes are of lead and of galvanized iron.

The population in 1880 was 3,500.

The capital stock of the company is $100,000, and the bonded debt is $90,000, at 6 per cent. interest. The works cost $160,000.

CCCLIX.—HOUSTON.

Houston, Texas, in lat. 29° 48 N., long. 95° 22 W., is on undulating land on Buffalo Bayou, an arm of Galveston Bay. It was settled in 1830. Water-works were built in 1878 by a private company. The supply is taken from the Bayou through a circular well 24 ft. in diameter and 24 ft. deep, at the bottom of which is placed a Worthington duplex steam pump of 12-in. bore, which lifts the water 150 ft. into a stand pipe, 20 ft. in diameter and 88 ft. high, of plate iron. In case of fire the water is pumped directly into the mains with 90 lbs. pressure.

Distribution is by 12 miles of cast-iron pipe, with 80 fire hydrants and 350 taps. The amount paid by the city for fire hydrants is not known. Service pipes are of galvanized iron.

The population in 1880 was 18,646. The daily consumption is about 300,000 gallons. No further statistics can be obtained.

CCCLX.—BROOKLINE.

Brookline, Massachusetts, is on the Charles River, opposite Boston, on undulating ground.

Water-works were built by the town in 1875, after plans of Edward S. Philbrick, C. E.

The supply is taken from the ground water in the valley of the Charles River, about 6 miles from the city. A gathering gallery was constructed about 200 ft. from the river, in clean, pebbly gravel and coarse sand, with its bottom 6 ft. below the lowest stage of the river. It is in two sections, respectively, 491 and 271 ft. long. The level of the ground water having been reduced by the constant draught, in 1880 the gallery was extended about 100 ft. and the pump-well lowered 2 ft., with the result of increasing the supply temporarily, until the ground water level was reduced to the same height above the well as before. The yield of the gallery is about 500,000 gallons daily. In 1880 a cross-ditch was cut from the river to within about 6 ft. of the side of the gallery, through which the river water can flow and be distributed along the side of the gallery, into which it will filter, without, however, being cleared of the great discoloration which characterizes it. This additional mode of supply has been used sometimes in summer when there is excessive use of water for street and lawn sprinkling.

From the gallery the water is conveyed 3,800 ft. in a wooden box conduit of 3-in. plank, and 2 ft. square inside, laid in sand and gravel 10 ft. under a saturated peat bog. This conduit leaked and supplied an indefinite quantity of water. It has caused a good deal of trouble by the sands entering it, and obstructing the flow.

The water is pumped by a Washington duplex tank engine of 2,000,000 gallons capacity through 2 miles of 16 and 14-in. pipe to a stand pipe and then through 2½ miles more of 16-in. pipe to a reservoir, built in excavation and embankment and containing 6,100,000 gallons, 160 ft. above the pumps. Distribution is by 23¾ miles of cast-iron pipes of from 16 to 2-in. diameter, with 164 fire hydrants, 18 water cart feeders, and 1,035 taps.

The population in 1880 was 8,100.

The number of taps in use at the end of each year and the daily consumption for the year, since 1875, have been as follows:

Year.	Taps.	Daily Consumption. Gallons.
1876	587	336,452
1877	702	352,042
1878	775	402,897
1879	857	460,000
1880	930	570,738
1881	1,013	477,113

The reduced consumption in 1881 is due to inspection of fittings and cutting off waste.

In 1881 the consumption varied from 407,481 gallons in March to 588,607 gallons in August.

The total cost of construction has been $621,530.83 to Jan. 31, 1882.

The expenses of maintenance in 1881 were $7,999.94 and the receipts $14,199.04. The town contributes in addition, for water used for public buildings, $6,497.50.

The works are managed by 3 water commissioners. F. F. Forbes is the Superintendent.

(TO BE CONTINUED.)

CORRESPONDENCE.

EXPANSION OF ROCK IN EMBANKMENT.

BOULDER, COLO., July 16, 1882.

EDITOR ENGINEERING NEWS:

I inclose data of an accurate test I made this year on expansion of solid rock from cut to embankment. The point chosen offered these advantages: material all solid rock, free from an overlying earth; surface uniform, admitting of accurate measurement; no possible settling of the embankment, as it was directly on the granite cow-pastures; volume of the work 9,000 cubic yards in 400 ft. lengths, reducing wastage from blasts to a minimum, and lastly, its location being such that I saw it several times every day. Results as follows: Rock in excavation and borrow pit measured in place 3,596 yds.; the same material, measured in embankment, yielded 5,337 yds., or an expansion ratio of 1 : 1.512;

the rock was granite and porphyry, but 10 per cent. of it broken to below 1 cu. ft., 85 per cent. ranging from 1 to 6 cu. ft. and the other 5 per cent. above 6 cu. ft. Other tests on a hard blue granite in larger masses varied from 1.6 to 1.8 yds. embankment to 1 yd. in place; but, owing to the large size of the pieces, the range was greater and tests less satisfactory. Should be glad of any information touching the subject.

ASST. ENGINEER.

MISSISSIPPI RIVER IMPROVEMENT.

EDITOR ENGINEERING NEWS:

In addition to the professional interest I take in engineering works, I have a taxpayer's interest in the proposed improvement of the Mississippi River, and were it not that the scheme has the professional endorsement of engineers of high standing, I should characterize it as one of the most stupendous "jobs" that ever sought Government aid, for, however cunningly the project has been concocted, and however ably it is explained and defended, there is no doubt that it covers an enormous amount of back scratching. Neither is there any doubt that it is opposed to Nature, and will surely fail. True, temporary local benefits can be effected by the construction of levees and wing dams, and these have led the Government into the adoption of the levee system, but every levee built necessitates the building of another a little further up stream, until, instead of the river bed that nature made lower than the plain, we have an elevated artificial aqueduct, the bottom of which is higher than the adjacent country, which must inevitably be inundated whenever the normal flow of the stream is augmented by spring freshets or excessive rainfall. The scheme, if persisted in, will, in course of time, force the river to escape from its artificial channel, and scour a new one through the valley beside it. The benefit that A derives from the construction of a levee will ultimately result in the destruction of the rest of the alphabet.

I think I understand the point made by the Commission, that to narrow the cross section of the stream by leveeing its banks will increase the rapidity of its flow, and scour out and deepen the channel, and so far true, but it does not stop there. The sediment taken up by the rapid current will be deposited in the slack water below, until, as the result of its own action, the height of the levee must be increased. But more than that, the increased current can be obtained only by increased surface slope, which is the same as saying that the level of the river above the levee is raised as a result of its construction, and so levee must follow levee *up* stream, until the turbulent, impatient river refuses to trail along the top of a ridge, and asserts its natural tendency to run down a hill by bursting through the walls that confine it, and carrying devastation and disaster into the plain below, and to the millions thrown away on the "improvement" must be added the millions of destruction with which the angry waters mock the futile efforts of men to subvert the laws of nature. If it is true that engineering science is responsible for such a plan, then the time is ripe for the advent of a little common sense. Capt. Cowden appears to know that water *will* run down hill, but it also appears that he lacks "infloonce."

A MICHIGAN SUBSCRIBER.

RECENT INVENTIONS.

SPARK ARRESTER FOR LOCOMOTIVES.

This improvement in locomotive spark arresters consists of a deflector or check plate secured at its top to the flue head of a tubular boiler, and at its sides to the smoke box. It is inclined downwardly and outwardly from the flue head, so as to present a discharge space for the products of combustion, which space is closed at its sides, and is of gradually increased transverse section.

NOVEL EARTH EXCAVATOR.

The excavator frame is mounted on wheels, and is formed of two parallel bars connected by cross bars, through two of which slide grooved, upright frames, vertically adjustable on tongued standards by screw rods with hand wheels. The forward frame has downwardly projecting arms, carrying an axle with radial cutters, and disk cutters attached to the ends of the said axles outside of the arms. The rear slide frame carries a plow cutter with vertical slide plates formed to force the earth up into an endless apron, with cleats running on two rollers, one carried by the plowshare standards, and the other by a frame sliding in straps on the top of the excavator frame, and having a chute. The roller in the sliding frame is connected by a universal joint with a pinion driven by a gear wheel on the shaft of one of the running wheels.

SLEEPING ATTACHMENT FOR RAILWAY CAR SEATS.

This invention consists of an attachment to the ordinary car seats of railway cars, comprising the combination of a supplemental reclining seat having a seat, back and foot and head-rest adjustably joined so that a person occupying it can secure any desired inclination. A projecting hood extends over the head-rest in order to shift the rays of light from the suspended lamps. The device is adapted to be folded up and stowed away during the day time.

FIRE ANNIHILATOR.

This improved fire extinguishing apparatus consists of a gas generator, which is supplied with a chemical reagent and an interior case supplied with explosive material, said case having loosely resting thereon a vessel containing also a chemical reagent. An electric battery and line wires are so arranged that when the electric current explodes the material within the interior case of the vessel will be upset and the fire-annihilating gas will be generated by intermingling the chemical reagents.

NOVEL METHOD OF GENERATING HEAT.

This improved process of generating heat employs a hydro-carbon furnace, in which the passage of air is secured under pressure through a fibrous incombustible fire-bed saturated with fluid hydro-carbons.

F. B. BROCK.

WASHINGTON, D. C.

THE DEATH RATE AT PANAMA.

UNIVERSAL INTEROCEANIC PANAMA
CANAL CO., MILLS BUILDING,
NEW YORK, July 17, 1882.

EDITOR ENGINEERING NEWS:

SIR: Permit me to call your attention to a paragraph which appeared in the last number of ENGINEERING NEWS headed "Panama Canal Service," in which you answer one of your correspondents who wishes to get employment in our company by saying, "probably they (his chances) are good, as the death rate is high."

I am a little surprised that a journal of the respectability of ENGINEERING NEWS makes itself the echo of the oft-repeated false statements published in the press antagonistic to our enterprise. You are aware that our Company has an office here, and it would seem that before you reproduced, unwittingly, I hope, the false statements or rumors about the death rate on the Isthmus, you would have applied to us for information. A few newspapers in this city have made themselves the disseminators of mis-statements written by disappointed correspondents who went to the Isthmus with a view to "being seen" and of papers representing interest in antagonism to our enterprise; but we rely upon the good faith and the love of "fair play" of the American people to do us justice.

The hue and cry against the Panama Canal, the result of the exertions of a few active antagonists with adverse interests, will gradually pass and wear itself away. In the meantime our Company will push operations, and the Canal will be built to be used by all nations. This building of our Canal, let me call your attention, will not be an exclusively French enterprise, as it has been so often erroneously asserted, and Mr. de Lesseps, in his last report to the stock-holders' meeting a few days ago, says very apropos:

"When in the midst of the organization of our works, last January, Mr. Hersent, one of the partners of the firm Couvreux and Hersent, went to the Isthmus to study personally how to best promote the work. Our consulting engineer, Mr. Danzats made the same trip, to prepare jointly with Mr. Hersent a programme for our second campaign to be submitted to our board of directors.

"The mapping out of this programme was particularly modified, owing to a few facts which we will lay before you, the importance of which will not escape you:

"On the 16th of February last some San Francisco contractors, Messrs. Huerne, Slaven & Co., signed a contract for digging the Maritime Canal to its full width and depth between Colon (Aspinwall) and Gatun and beyond, including six million cubic meters."

* * * * * * * * *

"A similar contract to that signed with Messrs. Huerne, Slaven & Co., for digging 10 kil. of the Colon side, has been offered us by an American company well versed in the business, for digging and finishing 10 other kil. of the Canal on the Panama side on very advantageous terms."

Let me add to what our honored President says that another American firm has received a contract for boring soundings over a large part of the Canal. A wharf we are building in Colon is also in the hands of an American contractor. A large number of the houses built on the Isthmus for our company have been built by Americans. We have in our employ American engineers, doctors, etc.

If the death rate is as excessive as you represent it, would it not seem strange that these men should undertake such serious work for the company?

To dispel this false impression about the health of the Isthmus, let me give you official figures;

FOR 1881.

Month.	Employed.	Deaths.
February	425	0
March	450	1
April	485	2
May	544	1
June	569	7
July	1,118	12
August	1,124	4
September	1,310	7
October	1,550	8
November	1,630	8
December	1,927	12
		62

FOR 1882.

Month.	Employed.	Deaths.
January	1,185	4
February	1,893	6
March	2,500	9
April	2,052	5
		24

Two large hospitals have been put up in Colon and at Panama, also at Gatun; and medical attendance is also provided for each of the working parties. Our medical officers have been able already to notice an improvement in the health of the personnel, and nothing will be spared in physicians, drugs, or quarters, for the prevention of disease and the comfort of the sick.

I did not intend to take so much of your space, but I have felt that it is perhaps time for our company to refute some of the many mis-statements which have appeared now and then in the press.

I am, very respectfully,
C. COLNÉ,
Secretary American Board.

JOHN BULL AND ARABI BEY.

"Arabi Bey," said a New York banker to a reporter, "is the most gigantic speculator in the world, and Gould, Vanderbilt, Russell Sage, and Keene are only infants in stock jobbing compared with him. Arabi Bey has for years speculated on a tremendous scale in the London, Paris, Vienna, Berlin, and other continental bourses through his secret agents. Some time ago he saw good reason to believe that Egyptian securities were going down. You see he had secret information in his possession. He at once proceeded to sell them heavily short in London, Paris, and elsewhere. There was a small decline, but the speculative fever ran high, and 'Egyptians' rose to a price at which Arabi Bey would have been subjected to heavy losses had he covered. Now John Bull and Johnny Crapaud are both heavy holders of 'Egyptians,' and naturally bulls. In taking these securities they both exhibited far more shrewdness than do the majority of the watchers of the 'tape' in Wall street. Each nation, in fact, appointed a commissioner, agent, or comptroller to proceed to Egypt to keep exact record of all revenues and expenditures of whatever nature. The commissioners were provided also with facilities to ascertain the condition of commerce, foreign and domestic, and of the crops. The reports of these authorities were to some extent reassuring, and the attempt to break 'Egyptians' failed.

"The attitude of Arabi Bey to-day and for some time past is only a desperate and reckless effort to bear 'Egyptians' so that he can cover. Where speculating and unscrupulous railway directors ruin railroads when they are short, and publish false statements when they are long, the canny Egyptian goes one better and does not hesitate to involve his country in war and sacrifice hundreds of lives in the pursuit of his stock gambling operations. Why, when Arabi Bey, months ago, was requested by the Sultan to desist from arming the forts, he replied he was only effecting necessary repairs. Perhaps the Sultan 'stood in' with him, for he did not make the request until the forts were about completed. Arabi Bey has had a chance to cover some of his short sales at a profit, and it is an open secret that he has agents at every stock exchange ready to obey his order. Why was not the Indian cable cut?

"This talk about Arabi Bey's national party is all humbug. So is his national banking scheme. The fact is that these agents, or Board of Control, or whatever you call them, have actually reduced the rate of interest considerably, and enhanced, to a certain extent, Egyptian credit. You can make money bulling 'Egyptians,' my boy, when John Bull gets through burning powder."

OIL SCOUTS.

THEIR DELICATE AND DANGEROUS WORK IN THE OIL REGIONS OF PENNSYLVANIA.

[From the Bradford Star.]

When an operator goes into an undeveloped field and puts down a test well he naturally desires to have the profit of his risk. It costs him something like $6,000 to put down that wildcat well, for which, in most cases, he gets no return, for the majority of wildcat wells produce nothing. If he finds a rich sand, however, and can keep it a secret for a while, he has a fortune in his hands. He can sell oil short knowing that when it is known that a new field has been discovered the price will go down. His most direct opportunity, however, is to lease the land in the neighborhood of his well, to be sold again at an enormous profit as soon as it is known that it is productive territory. So he guards his secret with every appliance he can invent. His most dangerous enemies are the "scouts." They are paid to discover what he is trying to conceal.

Almost every prominent oil broker has a "scout" regularly employed to keep him posted on the latest doings at the front. Daring, cautious, patient, untiring, unscrupulous, and honest, the scout must add to the experience of a driller the subtle judgment of a broker and the keenness of an operator. In the shadows of the night he earns his salary lurking about in the neighborhood of a new well out of gunshot of the guards about the derrick; lying often in the snow or in the swamp for hours, with his nose and ears stretched above the shelter of some friendly log to catch the smell of gas or the gurgle of flowing oil; sneaking up to the tank house to get a peep in if possible; watching the motion of the walking beam and estimating the depth of the tools thereby; ready to bribe a driller or exchange shots with a guard at a moment's notice.

He sometimes spends weeks watching one particular well. He studies the habits of the men working on it, notes if any of them are likely to succumb to the temptation of his brandy flask, jots down the hours when each one takes his nap, marks which way their faces are mostly turned in their rounds, and if he cannot court their favor, devises some scheme to get inside their guard and at their secret. In the gray of the morning he rides away to the nearest telegraph office and communicates with his employer before the market opens. It is a mystery when he sleeps. Almost any time of the day he may be seen loitering about wherever there is a crowd, picking up acquaintance with the few drillers whom he does not already know.

The emoluments of the work are occasionally of a size to compensate for any amount of hardship. For instance, "Si" Hughes, who got the Anchor Oil Company a pointer on 646, has been taken into the company with the office of superintendent and a clear tenth of their profits. His spring's work will net him not less than $150,000; but there is a well-defined path circling through the woods around 646, worn by the feet of those who worked as hard as he and got nothing but their salaries. How Hughes got his information is still a mystery. He is said to claim that he lay under the derrick for nineteen consecutive hours, but the prevailing impression is that he bought the secret from one of the guards.

In the course of an experience meeting the other evening with Capt. Peter Grace, one of the men who put down the 646 well in this district, he told me the true story of the mystery. Much has been written about it, more probably than was ever printed about an oil well before, but the Captain told me a few things which were new. This wonderful Cherry Grove district owes its development to the misfortunes of George H. Dimmick. He had been wrecked financially over in the Coal Creek region, and Capt. Grace set him to work out this way rather to give him a chance to recover than from any other motive. Land could be leased for a dollar an acre, and the experiment was not very costly.

"When the tools broke through the shell of the sand about 10 o'clock on the morning of the 11th of March," said Capt. Grace, "we knew we had found wealth. The oil filled up a hundred feet before we could get the tools out. The pressure of gas was tremendous. We drove a tight-fitting wooden plug, 8½ feet long, to the bottom of the well, poured the hole full of oil, screwed in the casing head, and set the tools, which weigh not less than a ton, on top of it. Even then when the well flowed it blew the casing head off and sent the tools a flying up the derrick.

"One trick we played to deceive the scouts I think has never got into print. I took a torpedo man into a room in the hotel at Warren one day, very mysteriously, but took good care to have a scout see me do it. Of course the scout immediately hid himself in the adjoining room. I told the shooter, with my voice trembling, that I had put my last dollar into the 646 venture, and had found no oil. I must get some appearance of grease in order to sell my lease and get out whole. I arranged with him to go out that night and torpedo the well. Well, we went out with a make-believe torpedo filled with water. The scouts were at our heels, of course, and watched every motion. We went to the well in the dead of night, and there went through the form of shooting the well so accurately that even the guards about the well were deceived. The next morning they complained that the smell of the dynamite had given them the headache. Sharp as they were, the scouts were all taken in, and did not find out the trick until weeks afterward."

VILLARD'S GREAT SURVEY.

PROF. PUMPELLY'S RESEARCHES IN THE REGIONS BETWEEN MINNESOTA AND THE PACIFIC COAST.

It lacks a few days of a year, says the New York *Sun*, since the directors of the Northern Pacific railroad and of the Oregon Railway and Navigation company jointly organized the Northern Transcontinental survey. The work owes its inception to Mr. Henry Villard, the president of the two corporations. As originally planned the undertaking contemplated the exploration of the vast land grant of the Northern Pacific, a belt from twenty to forty miles in width, extending from Minnesota to the Pacific ocean, and comprising 40,000,000 acres. The Northern Pacific charter does not authorize the building of the lateral roads in connection with the main line. But the capitalists of the Oregon and Northern Pacific companies have formed a construction company for the purpose of building these branch lines, and they have thus become interested in all the unknown regions north and south of the Northern Pacific belt. The original scope of the Northern Transcontinental survey, in consequence, has been widened. Instead of the narrow belt, the field of exploration now consists of the parallelogram shown on Prof. Pumpelly's little map—a territory 1,500 miles in extent from east to west, and 500 miles from south to north, more than half a million square miles in area.

The idea of the suvey is strictly utilitarian. The agricultural and mineral resources, soils, and their adaptability to farming, the kind and extent of timber lands, temperature and rainfall, entomology in its relation to agriculture, coal deposits and their value for manufacturing purposes, and the like, are embraced in the scope of the exploration.

The work is of greater magnitude than any exploration ever undertaken by private enterprise, and no government expedition, unless it be that of Clarence King along the fortieth parallel, ever undertook to achieve the results anticipated from this undertaking. It is to be a work of years and millions. Unlimited funds are at the command of the explorers, and probably $2,000,000 will be spent in completing the work mapped out. The director of the Northern Transcontinental Survey is

PROF. RAPHAEL PUMPELLY.

the explorer and traveler who has spent a lifetime in work of this kind. He is a native of Ithaca, N. Y. After a course of preparation in the mining schools of Paris, Hanover and Freiburg, he started in his profession in the mining fields of Arizona. Here he spent two years. Next we find him in the employ of the Japanese Government, exploring the island of Yezo; then in the service of the government of China, by whom he was employed to report upon the coal supply of that country. That work finished, the professor set out for the United States, overland through Mongolia, Siberia and Russia, about which he wrote most entertaining volumes. In 1866 he became Professor of Mining Engineering at Harvard; in 1870-71 surveyed the Michigan copper fields; in 1873 was State Geologist of Missouri, and in 1880 had charge of the coal and iron reports of the United States census. He entered upon his present work July 1, 1881, and is now at Helena, M. T., his field headquarters, superintending the work of his army of geologists, chemists, topographers, botanists, entomologists and other experts. Prof. Pumpelly's staff is composed of the following persons: Prof. E. W. Hilgard, of California University, Department of Soils; Dr. Herman A. Hagen, of Harvard, entomologist, with Samuel Henshaw as assistant; Prof. A. D. Wilson, of the Hayden survey, chief topographer, with Messrs. Louis Nell and R. U. Good, assistants; Prof. Sargent, of Bussey Institution, Harvard, Department of Forestry, with Messrs. Brandagee and Putnam, assistants; Prof. William M. Canby, Department of Forage Plants; Messrs. Bailey Willis, son of N. P. Willis, George H. Eldridge, and Bayard Taylor Putnam, son of George P. Putnam, geologists, with R. C. Templeman and George W. Driver, assistants. A complement of young men from various scientific schools and colleges, laborers, guides, packers, cooks, etc., make up the army of invasion, and more recruits are going forward this summer. One enlistment recently was that of Mr. J. E. Wolf, of the Cambridge Museum of Comparative Zoology, who will join Geologist Eldridge's party in Montana in a few days.

THE OFFICE HEADQUARTERS

of the Northern Transcontinental survey are in Newport, R. I. They occupy every room from cellar to roof of an old, wide-spreading two-story frame house at the intersection of two very narrow, old-fashioned streets. A bronze knocker of mediæval pattern, and of a weight that indicates that it must have been forged by some armor-wearing stalwart of the middle ages, is the means by which the visitor makes known his presence at the front door. To the right of the capacious hall, which is lined with boxes and a miscellaneous assortment of nature's bric-a-brac, is the business office where the accounts are audited and the financial affairs of the expedition are duly adjusted. Across the hall on the left is the library, a very valuable and complete collection of scientific works, the property, in part, of the survey, and partly belonging to Prof. Pumpelly and the census office. This department is under the charge of Mr. Richard Bliss, Jr., the bibliographer.

The entire upper story of the building is used as a laboratory by Dr. F. A. Gooch, of Cambridge, chief chemist to the survey, and his assistant, Prof. William T. Richmond. Every few days mysterious-looking bags of great weight are lugged up the front stairs and carried into the workshop of the chemists, where their contents are put through the fiery ordeal, and a message announcing the result goes back to the geologists who are working the diamond drill in the hills of the Northwest. Some of the experiments that Professor Pumpelly desires to be made are on a scale beyond the capacity of the Newport laboratory, and the resources of other works are drawn upon. At the present time Prof. Gooch is over in Pennsylvania with a car-load of Montana coals for the purpose of testing their cooking qualities.

The work of the survey has not yet reached a stage where it is possible to group results. Last year a beginning was made by Geologists Willis and Eldridge, who made explorations in Washington territory and in Montana, and as far north as Manitoba. The result was the discovery of extensive beds of bituminous and lignite coals of great value. The explorers returned to Newport for the winter, and started for the wilderness again a few months ago. They are now in the Butte and Helena coal-fields. As Prof. Pumpelly is with them in person, the new discoveries are reported direct to him. In the autumn the explorers will return to Newport and prepare their reports, which Prof. Pumpelly will submit to the companies. By the time the northern route to the Pacific is open, on the 1st of July, 1883, it is probable that the results of the survey will in part be given to the public.

One of the most important of recent discoveries is a tract of valuable timber land 100 miles long and seventy-five miles wide, on the Clark's Fork branch of the Columbia river.

The discoveries of the explorers are not heralded to the world as soon as they are made, for obvious reasons. The two railroad corporations own only a small part of the lands on which the explorers find treasures.

PROGRESS OF ELECTRICITY.

The Midland Brush Electric Light and Power Company have offered to light Boston (Lincolnshire) for one year for the average of three years' cost of gas—about £900—giving 80,000 candle power of lights in the place of the 5,000 candle power now obtained from the gas lamps. The result of the five months' experiment with the electric light at Chesterfield has been eminently satisfactory. The cost has been found to be considerably under that of gas, while a superior light has been obtained. The corporation has decided not to return to the old system of gas-lighting, and Messrs. Hammond have been ordered to supply further lights. An influentially signed memorial on the subject of the introduction of the electric light into large city warehouses has been presented to the City Commissioners of Sewers. The memorialists state that they would be willing to enter into contracts with the electric companies to supply them with the light from cables laid in the street, and they, therefore, prayed that the court would grant to the electric lighting companies the right of lighting private houses, shops and warehouses, any contracts entered into to be for a period of not less than three years. It is stated that electric lights are being erected along a portion of the Surrey Canal, and it is probable that the whole length will eventually be lighted by the same means. The Laing electric light was successfully tried on Monday night in Waterloo Place and lower Regent street, the gas being extinguished for the time being. The authorities of the parish of St. James are reported to have in contemplation the use of this light in the whole of Regent street. The latest account of the progress that has been made in laying mains, etc., for the New York lighting-station of the Edison-Company states that, prior to April 1, a little over 55,000 ft. of street underground conductors had been laid. The total amount of mains laid during April was 12,500 ft., and on May 1 there yet remained to be laid about 14,800 ft. Three out of the six large dynamos that are eventually to be erected in the central station in Pearl street are now being erected there. The others are ready and will follow as soon as the first three are in place. Stafford House was on Friday night last week lighted by the incandescent light. The experiments were carried out by the British Electric Light Company, and the number of lamps in use was 258, each of 20-candle power. The machinery was driven by a steam-engine of 20 horse-power. There were six Gramme dynamo machines, with two feeders. It was shown that there was no danger by coming into contact with the wires, and that the lamps could be separately or collectively extinguished or removed at will. The works in connection with the electric tramway between Portrush and Bushmills, County Antrim, are now approaching completion, and it is expected that the line will be formally opened for passenger, goods, and general traffic by the Lord-Lieutenant early in August. The Commissioners of Sewers of the City of London, having advertised for tenders for lighting certain districts with the electric light, it appears that the cost of applying it to the four districts into which the principal city streets had been mapped out varied from £9,500 to £17,000. The lowest contract in one district was £2,190, and the highest £5,700. The gas consumed in the whole of these districts was only £1,860 per annum. The Crystal Palace authorities have decided to continue the lighting of the terrace throughout the summer months by the André system of electric lighting, and have sanctioned the extension of this system over the track of the new electric railway which is about to be opened in the grounds. —*The Ironmonger*.

THE PANAMA CANAL.

The Panama Canal Company has held its first annual meeting of shareholders. The operations during the first year have been quite preliminary; but M. de Lesseps, in the report read, reminded proprietors, who have manifested some impatience to see the digging of the canal commenced, that according to the original plans the period of organization would not terminate before the end of 1882. The results attained, he said, had only tended to confirm the belief that the canal could be opened within six years from the commencement of the work of excavation. A great portion of the geological formation through which the canal will be made had been classed as "hard rock;" but more complete surveys have proved that much of it consists of sand, common earth and soft rock that may be excavated without boring. This discovery will permit the company to effect a considerable saving in the cost of the work. Returns of the sanitary condition of the Isthmus also show that the death rate among the personnel of the company has not exceeded that among large assemblages of workmen in Europe. During the first four months of 1882 the average number of persons employed was 2,060, and the number of deaths from age, accident or malady averaged six only per month. The first call on the capital subscribed produced a sum of about 74,000,000 francs, of which 40,000,000 still remained unemployed at the end of the year, and the second call of 125 francs per share on 590,000 shares, made at the commencement of the year, was duly met. It was originally proposed that of the 600,000,000 francs required for the construction of the canal, 300,000,000 would be obtained by shares and 300,000,000 by the issue of bonds. The meeting authorized the Board to issue a first series of 250,000 5 per cent. bonds. Of that loan a sum of 60,000,000 francs will be employed for the payment of the last four annuities of the purchase of the Panama Railway. By that purchase the company secures an entire monopoly in the transit across the Isthmus, and will be able to utilize the railway, its wharves and quays, for the construction of the canal.—*The Economist*.

ON THE ISTHMUS.—PANAMA, July 11.—The *Star and Herald* having accused the canal company of doing business as a commercial concern and thus competing with taxpaying merchants, considerable excitement has followed. The proofs of the correctness of the statement have been tendered the canal company, which appears loth to move actively in the matter. The agitation has caused the canal company to stop private trading. Machinery is arriving every day for it at Aspinwall, and each fresh arrival is causing serious loss to the company. Parts are being lost or mislaid, while the general whole becomes every day more mixed in its management and progress. Machinery and wood-work for the canal are now submerged, owing to the heavy rains. When required it will be next to impossible to find certain parts, while a great deal of it will have been totally destroyed. The sanitary arrangements on the Isthmus are abominable, so it is no wonder the new comers are dying. Out of a population of 4,000 twenty-three persons have died in the past week, or an average of three a day. There is little hope for any improvement until the dry season sets in.

NOTES.

AN EGYPTIAN RAILROAD.

The dreariness of the country between Alexandria and Cairo is such that even Arabi Pasha's soldiers can hardly increase it, though they certainly appear to have done their best toward that laudable end. The ingenious three-handed game of robbery now being carried on in the Nile Delta, the soldiers plundering the peasantry and the Bedouins plundering the soldiers, is intensely characteristic of the East. But it would require a rich booty indeed to tempt any man to remain long in such a region. From the magnificent cathedral-like depot at Alexandria right onward to the gates of Cairo the whole country is one unbroken flat, scorched by a vertical sun, and presenting everywhere the glaring contrast of a riotous luxuriance of vegetation wherever water runs, and a barrenness like that of the Sahara itself wherever it does not. The dust is simply indescribable. Despite the Venetian blinds with which all the cars are provided, floor, walls, and roof are literally gritty before Alexandria is out of sight; and when the passengers begin to shake and brush their clothes toward the end of the journey, every car is the scene of a kind of miniature sand-storm. Add to this the assiduities of innumerable flies and mosquitoes, and the fact that the ordinary trains take four an a half hours to cover a distance of less than one hundred miles, and it will be seen that the journey is more of a toil than a pleasure.

TELEGRAPH POLES.

In a new decision by the Missouri Court of Appeals, in the matter of a property owner's petition for injunction against a telegraph company, which had put up a pole opposite his premises under a permit from the Board of Public Improvements, it was stated that the power of the Board to give such permits might be so limited as to exclude the erection of anything unsightly.

CURIOUS WEAPON.

A curious piece of artillery has arrived at Windsor Castle. The weapon, which is believed to have come from some Eastern country, has seven barrels, the bore of which is rather larger than those of ordinary rifles, laid horizontally upon a wooden carriage, the central one being longer than the rest. At the breech is a groove for a train of powder to the touchholes, so that all the barrels can be discharged simultaneously.

THE CITY OF ALEXANDRIA, which is now paying so dearly for its passing notoriety, may be defined as a level Algiers, its chief defect being the utter absence of those picturesque heights which add so much to the beauty of the magnificent capital of Algeria. The old harbor is now almost entirely dismantled, and the basin allotted to foreign shipping runs right up into the town. The railway to Cairo, striking off from the southeast side of the town, passes over a sandy flat, completely exposed to the fire of any large vessel at anchor in the roadstead. Three miles west of the city, and connected with it by a line of horse cars, lies Ramleh, which represents the "up town" of this Egyptian New York, and contains the villas and gardens of many of the wealthier residents. The environs of Alexandria are as flat and sandy as Coney Island itself, and the dust is quite unbearable in the hot season, which reaches its height in August. The most ornamental part of the city itself is the Grand Square, a magnificent open space adorned with fountains and thickly planted with tropical shrubs and trees, under the shade of which scores of loungers sit every evening to listen to the music of the band. All the best shops are in this quarter, and its sidewalks form a fashionable promenade. Several of the larger hotels of Alexandria are built facing the sea, and during the hot season it is customary to serve dinner by moonlight on a platform overlooking the water, the plash of the waves below keeping time to the rattle of knife and fork above, and the "ping" of the all-pervading mosquito. The most prominent object in the night view of the city is the Pharos, or great light-house, which is well worth a visit.

WHAT A VOLCANO CAN DO.

Cotopaxi in 1833 threw its fiery rockets 3,000 ft. above its crater, while in 1854 the blazing mass, struggling for an outlet, roared so that its awful voice was heard for more than 600 miles. In 1797 the crater in Tungurangua, one of the great peaks of the Andes, flung out torrents of mud which dammed up the rivers, opened new lakes, and in valleys 1,000 ft. wide made deposits 600 ft. deep. The stream from Vesuvius, which in 1837 passed through Torre del Greco, contained 32,000 cubic feet of solid matter, and in 1793, when Torre del Greco was destroyed a second time, the mass of lava amounted to 45,000,000 cubic feet. In 1760 Ætna poured forth a flood which covered 84 square miles of surface, and measured nearly 1,000,000,000 cubic feet. On this occasion the sand and scoria formed the Monte Rosini, near Nicholosa, a cone of two miles in circumference and 4,000 ft. high. The stream thrown out by Ætna in 1819 was in motion, at the rate of a yard a day, for 9 months after the eruption; and it is on record that the lava of the same mountain, after a terrible eruption, was not thoroughly cool and consolidated for 10 years after the event. In the eruption of Vesuvius, A. D. 79, the scoria and ashes vomited forth far exceeded the entire bulk of the mountain; while in 1660 Ætna disgorged 20 times its own mass. Vesuvius has sent its ashes as far as Constantinople, Syria and Egypt; it hurled stones 8 lbs. in weight to Pompeii, a distance of 6 miles, while similar masses were tossed up 2,000 ft. above the summit. Cotopaxi has projected a block of 100 cubic yards in volume a distance of nine miles; and Sumwaba, in 1815, during the most terrible eruption on record, sent its ashes as far as Java, 300 miles away.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

THE LONDON, ONT., WATER-WORKS.—Mr. Tracy, the city engineer, reports that Messrs. Stevens, Turner and Burns have completed all the suction pipes for the new works, the "bend" being the only pipe that remains to be finished. He expects to see the pumps running in a very short time.

WATER-WORKS EXTENSION.—The Water Board of Holyoke, Mass., is laying about 1,000 ft. of 8-in. pipe on Commercial street.

A STAND PIPE, 80 feet high and 4 feet in diameter, has been erected at the Calumet mine, Mich., in connection with water-works. The pipe will hold about 75,000 gallons. The pipe is now being inclosed in a wooden tower, which will, when finished, have rounding stairs to the top, from where a good view of the surrounding country will be obtained.

BOSTON WATER.—A note from Boston says: "A petition, of which the following is a copy, is in circulation and will be presented to the Committee on water:"

"We, the undersigned, citizens of Boston, grieved at the continued bad condition of the city water, and realizing that the present management have thus far failed to adopt measures of relief, earnestly petition that the Board of Health be furnished with necessary means, and directed to make a thorough and impartial examination of the subject, and report at the earliest day such measures of relief as to them may seem necessary."

THE Schuylkill water trouble is, on the whole, worse than the Cochituate trouble which lately afflicted Boston. The pollution of the Boston supply was at first supposed to be due to dead eels, and this was not an agreeable hypothesis; afterward the theory prevailed that the bad odor and taste were produced by a fungous growth, and although this solution was not wholly reassuring, it seemed less disgusting than the other. But the Schuylkill for sixty miles has of late been soapy and of a dark green color, has left a white deposit on its banks, and has been killing its fish by thousands. The stench of those heaps of fish, as they float in the water or putrify on the banks, is sickening, and people have become ill along the river, either through imagination or from the foul effluvia. Black bass, sunfish and chub alike fall a prey to this poisoning, and the minute white particles which fill the river are found to be chemically acting on the gills of such dead fish as have been examined. The theory generally received is that sulphur water from abandoned collieries in the Schuylkill coal region has been pumped in unusually large quantities into the affluents of the river. For many years between Reading and Philadelphia all sorts of factories have been allowed to turn their refuse into the river, often so near the pumping works of cities as to leave a narrow chance for the water to be reasonably settled and clarified. But corporate greed eagerly insists that this cheap and convenient mode of disposing of refuse really gives body, sparkle and aroma to the drinking water of a million people—that, for example, the sulphurous acid turned into it nicely counterbalances the excess of limestone water from the creeks, and so gives a finer flavor. This philanthropic addition of extras, without charge, has now been overdone, and Pottstown and Norristown are living on the supplies in their reservoirs until some solution of the difficulty is reached.—*N. Y. Sun.*

INCORPORATED GAS COMPANY.—The Sycamore Gas Company of Sycamore, Illinois, has been incorporated. Capital $40,000.

THE GAS REPORT OF SAN FRANCISCO.—The annual report of the Gas Inspector, as filed in the Clerk's office of the Board of Supervisors, shows that during the year 9,284,500 ft. of gas were consumed in the public buildings and 1,226,100 ft. in the Fire Department, making the total consumption 10,510,600 ft. The average candle power for the year was 17.152. The expenses of the office amounted to $1,941.95.

WATER SUPPLY OF SHARON, MASS.—At a meeting of prominent citizens, held last Saturday, a committee was appointed to make all necessary investigations and report to a future meeting. This is a question of great interest to Sharon, as the springs are so far from the surface in the center of the village that it is necessary to sink wells 60 ft. deep to obtain water.

THE Lynn (Mass.) Gas Light Company will pay a semi-annual dividend of 2½ per cent. on July 24.

CINCINNATI WATER-WORKS REPORT.—The forty-second annual repoot of the Water Department of the city of Cincinnati, for the year ending December 31, 1881, has just been issued. With the exception of last year's report, which was especially noteworthy, containing as it did a complete history of the Water-works department, the volume is about the best that has appeared. Superintendent Arthur G. Moore presents a concise statement of the work of the past year. The volume is replete with tables of interest, and not the least of these are the plates relative to the western hills disaster in the bursting of the tank. The annual receipts for 1881 (rents) amounted to $478,991.38 and the expenditures to $217,529.07, not including $102,285.80 interest on the $1,685,000 bonded indebtedness which exists. The sum of $130,709.14 was expended for new improvements. During the year the city consumed 8,397,654,200 gallons of water, being an average daily consumption of 23,007,272 gallons. The percentage of increase over 1880 is considerable—18.13. There are in use in the city 196.14 miles of iron pipe, with 24,256 branch services. Of this number over seven miles were laid last year. The sections relative to smoke consumption and the investigation of the charges of contaminating the river water are not the least of interest. To the report is added a table of the daily stage of the Ohio River at 6 o'clock p. m. during 1881. From it it is to be seen that in 1881 the river was the highest on Feb. 15, when it showed fifty feet seven inches in the channel, and lowest on Sept. 10, when there was but one foot and eleven inches registered there.

A WASHINGTON, D. C., paper states that there is a scarcity of water in the southwestern portion of that city. A move is on foot by the citizens in that part of the city to make application for an additional 12-inch main, connecting B street south with B street north, and to extend to the large main on Pennsylvania avenue.

THE SWAMPSCOTT WATER COMPANY, Captain Isaac N. Jackson, President, drove twenty tubular wells, each to a depth of thirty feet, last winter, in the district lying between the Pine Street School House and New Ocean street. Water has flowed from them up to the present time. A pump has recently been applied to them, and for the twenty-four hours preceding 8 a. m. to-day the yield was 800,000 gallons. A larger pump will be put in to test the capacity. Swampscott has no public water supply at present although she greatly needs it. The Swampscott Water Company says that if every house in Swampscott was connected with a public water supply the consumption would not exceed 250,000 gallons daily. As it is believed that no more than 60 per cent. of the houses would be connected within five years, it is argued that the consumption for that time would not reach the above figures. This place of pumping is in the basin of Stacey's Brook, which stream has its head at Flax Pond.—*Boston Journal.*

ELECTRICITY.

THE ELECTRIC LIGHT came to the front early in England's war on the Egyptians. On a dark night preceding the bombardment a brilliant beam was flashed to the shore from one of the English vessels, lifting the cover of darkness from the enemy's operations along the water-front. When the Egyptians found themselves working in full view of the men on the vessels, under the glare of a light which seemed almost as brilliant as that of the sun, the startled natives fled. Then the beam of light was swept along the shore, revealing other squads of the Egyptian force, which fled across the limits of the illuminated space into the darkness. It is perhaps not too much to infer that the natives were surprised.

OCEAN CABLES.—The New York Board of Trade and Transportation have sent a memorial to Congress in opposition to the Senate bill "to encourage and promote telegraphic communication between America and Europe," which was recently passed.

THE TELEPHONE AT ALEXANDRIA.—H. H. Eldred, formerly station agent at Passaic City, was sent to Europe to introduce the telephone in the Southern part of the Continent. He had just finished his work at Alexandria, where he obtained a large number of subscribers, and, being at Malta, conducted the experiments which resulted in hearing the noise of the guns at the late bombardment through 1,000 miles of wire. Communication, however, was suddenly cut off, for a shell from one of the 81-ton guns exploded in the cellar of the Alexandria central office, and the next instant there was nothing but a hole where the central office building had stood. These facts were learned through a cable message from Mr. Eldred.

ELECTRIC LIGHT COMPANY INCORPORATED.—The Rock Island County Electric Light Company, of Rock Island, Ill., has been incorporated. Capital, $24,000.

STREETS, DRAINAGE, ETC.

Robert J. Graham, Superintendent of Streets, has filed his annual report with the Board of Supervisors. The report shows that no work has been performed on unaccepted streets, except by property owners, under private contracts. The Superintendent calls the attention of the Board to the condition of the Redwood sewers in various portions of the city, especially in the southern part. The Board is also reminded that the wooden sewer in Fifth street, from Folsom to its outlet, has no bottom most of the way, and that quicksand rises to such a height in the sewer as to seriously obstruct the flow from connecting sewers, rendering it almost impossible to maintain a proper drainage in the locality south of Folsom street, between Fourth and Sixth. Mr. Graham says in his report that early and efficient means are essential to avoid the sanitary evils that will arise under the present sewerage system in the southern part of the city. During the past year 5,105 lineal feet of grading has been performed on the streets, and 4,012 feet of macadam, 5,564 feet of paving, 1,375 feet of planking, 1,228 feet of sidewalks, 412½ feet of cross-walks, 3,518 feet of curbs and 760 feet of gutterways were laid. From July 1, 1881, to July 1, 1882, 3,188 feet of sewers were constructed, making a total of 131 miles and 216 feet of sewers constructed since July, 1858. From July 1, 1881, to July 1, 1882, 4,921 feet of streets were accepted, making the total length of accepted streets in the city 48 miles and 3,153 feet.

The following is a statement of the amount of money drawn from the Street Department Fund during the the past fiscal year:

Wages for labor on streets	$51,837.25
Wages for labor cleaning sewers	20,800.25
Material and tools used on streets	31,738.92
Street sweeping, eleven months	73,885.31
Rent of Corporation Yard	670.00
Salary of keeper of same	1,200.00
Work by contract on city and government property	787.00
Judgments against the city	9,432.99
Sprinkling Golden Gate and Van Ness avenues	2,010.65
Paid City and County Surveyor	997.98
Bridge tender, Sixth street bridge	455.00
Street work directed by Board of Supervisors	4,984.15
Labor along city front	5,965.50
Material used on same	16,372.37
County roads	9,558.00
Printing and stationery	382.90
Total	$230,856.56

—*San Francisco Chronicle.*

AN EFFORT is being made to build sewers in the unsewered parts of Cincinnati, and a bill authorizing a tax levy has been prepared.

STREET PAVING.—Fair progress is being made with the street pavement improvements in Springfield, Ill.

MONTREAL STREETS.—Montreal is getting in about the same muddle with its streets as that from which Toronto is just escaping. In the last ten years the sister city has spent $1,500,000 on her streets, and has nothing to show for it. The City Surveyor, Mr. Ansley, seems to favor the frontage tax system, which is proving so successful here. We fancy, however, it will be years before the necessary legislation to create a frontage tax system can be procured in Quebec. In the meantime the streets will become worse.—*Toronto Globe.*

FIRST WATER, THEN DRAINAGE.—Now that Atlantic City, N. J., has secured a long-needed water supply, it is beginning to move for the satisfying of another great want—a good system of drainage; and a company with a capital of $500,000 has just been chartered for this purpose.

RIVERS AND HARBORS.

DRY DOCKS WANTED.—A number of ship-owners and agents of Montreal, feeling the need of dry docks accessible to sea-going vessels, are discussing the advisability of supplying the want. On this subject the *Globe* speaks as follows: "There have for some time been two commodious private dry docks in connection with the ship-building establishments on the canal, but until the new canal was opened this spring they were only accessible to the smallest class of sea-going vessels. The firms owning these docks, moreover, having as much as they can do with river craft have not furnished their docks with the appliances for repairing sea-going vessels. The plan which has been brought to the notice of our shipping men is to form a joint stock company, and build a large dock beside the Wellington Basin, with forges and apparatus for repairing iron ships, and to keep a staff of competent workmen permanently engaged. The estimated cost is $850,000. Already this season nine ships have had to be sent to Quebec for repairs in the dry docks, and to be brought back again for their cargoes, and some vessels have been sent to sea sadly in want of repairs. This morning the bark Amiens was dispatched to Quebec for repairs to the copper sheating on her bottom, which will probably take a couple of hours. She will then be brought back for her cargo, after incurring a loss of some $540 for pilotage and tonnage."

CANAL PROJECT.—One of the latest of canal projects is that of a waterway between Liverpool and Manchester, England, so as to make the latter place accessible at all times by large sea-going vessels. The lowest estimate of the cost is $25,000,000.

CANALS.

THE NICARAGUA CANAL.—On the 17th the House Committee on Foreign Affairs began the consideration of Representative Rosecrans' bill, which provides for the incorporation of the Maritime Canal Company, of Nicaragua. The incorporators proposed by the bill are Messrs. U. S. Grant, E. D. Morgan, H. J. Jewett, Howard Potter, William R. Garrison, Frederick Billings, George B. Loring, William L. Merry, William B. Franklin, Solon Humphries, Frederick Butterfield, J. Thomas De Franco, James R. Keene, Richard Ten Broeck, E. F. Beale, William Dennison, Edward C. Anderson, Daniel Ammen, George F. Baker, Alexander Taylor, U. S. Grant, Jr., William H. Barnum, E. F. Riggs, Edward M. Clymer, A. G. Menocal, Charles Dana, Robert Harris, Manuel Caudra, Edward F. Smith, James H. Work and S. L. Phelps. The bill provides that the capital stock of the company shall consist of not less than 500,000 nor more than 1,000,000 shares of $100 each, which shall in all respects be deemed personal property, 10 per cent. of all subscriptions to the capital stock to be payable at the time they are made, and all future payments to be made at such times and in such amounts as the Board of Directors may determine, sixty days' previous notice to be given of the payments required and of the time and place of payment by publication in one daily newspaper in New York, San Francisco, London and Paris. In case any stockholder shall neglect or refuse to pay in pursuance of such notice the stock held by him is to be forfeited absolutely to the use of the company and also all payments made on account thereof, but the Board of Directors is empowered to allow the redemption of the stock on such terms as the board may prescribe. The bill also provides that the United States shall exercise such control over the canal as is now or may at any time be prescribed by treaty with Nicaragua, and shall enjoy its free use for transportation of troops, munitions of war and mails and otherwise in accordance with stipulations in existing treaties, and should the United States see fit for national reasons to temporarily occupy and manage the canal the right to do so is reserved and secured to the Government upon the payment to the stockholders of the canal at the rate of 5 per cent. annually upon the capital invested, together with the necessary expenses for the maintenance of the work.

ONE of the latest of canal projects is that of a waterway between Liverpool and Manchester, England, so as to make the latter place accessible at all times by large sea-going vessels. The lowest estimate of the cost is $25,000,000.

RAILROADS.

THE stockholders of the Scioto Valley Railway Company voted on the 14th to extend the road from Columbus, O., to Fort Wayne, Ind., increasing its length from 150 to 300 miles. The capital stock was increased from $5,000,000 to $10,000,000, and a new consolidated mortgage for $1,500,000 was authorized.

THE total railway construction of the year to June 15 was 3,650 miles.

WITHIN six months 1,800 new stations have been added to the railroad index.

EIGHT THOUSAND Chinamen are on their way to work on the Canadian Pacific.

THE railroad earnings show increase of dividends all the way up to 194 per cent.

AT Portland, Or., an immense railroad depot is to be erected, to cost $1,500,000.

A RAILROAD bridge is being built across Escambia River, Florida, that will be two miles long.

TRACK-LAYERS are 826 miles beyond Duluth, on the Northern Pacific. Seven thousand men are at work.

A NARROW-GAUGE road, 90 miles long, costing $2,000,000, will be built in Mono County, Cal.

THE 70-mile gap, on the Northern California & Oregon road, will occupy 2½ years to build.

THE dividends paid by the railroads last year amount to $1.52 pee inhabitant. The net earnings of all the railroads were $255,000,000.

THE large iron viaduct at Cleveland of the New York, Chicago & St. Louis road will be 3,200 ft. long. The road will be in operation by the 1st prox.

SIXTY-THREE railroads, covering 47,688 miles, show in their reports an increase of 13½ per cent. One-half of one per cent. was the average increased earnings per mile.

HE DIDN'T KNOW HIM.—At a station on one of the railroads leading out of Detroit the train had arrived and departed the other day, when the station agent, who had been in the place about three weeks and was looking for a call every hour to come to Detroit and take charge of the line, was approached by a quick, well-dressed man, smoking a cigar, who asked:

"Keep you pretty busy here?"

"Yum," was the jerky reply.

"Business on the increase?"

"Yum," again.

"Do you run this station?" asked the quiet man, after a turn on the platform.

"Nobody else runs it," growled the agent. "Have you got a patent car coupler?"

"Oh, no."

"I was going to tell you to go to thunder with it if you had. Want special freight rates, I suppose?"

"No, sir."

"I don't give any passes."

"I don't want any."

"Waiting for the next train?"

"Not particularly."

"Want to charter a car?"

"No."

The agent left him on the platform, and entered his office and busied himself for half an hour, when the quiet man looked in on him and asked:

"What's the salary of a position like this?"

"That's my business," was the prompt reply.

"What's the income from this station?"

"Ask the Baggageman."

"Your name is —— ——, isn't it?"

"Suppose it is?"

"Oh, nothing much—only I'm the General Manager of the line, and I'd like to exchange cards with you."—*Weekly Review.*

The headquarters of the New York & Boston Inland Railroad Co., is 209 Washington street, Boston, Mass.

The Air-Line Railroad.—New Albany, Ind., July 17.—The Air-Line Railroad Company is pushing things and getting ready to put on trains. All day yesterday a large force of men was employed putting in a turn-table at the round-house at West Sixth street, and expect to have it completed to-morrow. The contractors expected to complete the track through Potten Tunnel, below Hartford, to-day, when the last rail will be laid.

Large Earnings.—The more than $4,000,000 earned by the Pennsylvania Railroad last month is the biggest railroad earning on record in the world.

A Projected Ohio Road.—It is proposed to build a road from Wooster to Burbank, 15 miles north, and there connect with the New York, Pennsylvania & Ohio. The estimated cost is $50,000.

Saratoga's New Railroad.—The Mount MacGregor Railroad, the narrow-gauge road running to Mount MacGregor from Saratoga, has been opened to the public. This new road is some two miles in length, with grades in some places exceeding 400 feet to the mile. It promises to become another of the many attractions which Saratoga Springs offer to summer visitors.

An Indiana Road Incorporated.—Articles of association of the Kankakee Valley Railroad Company have been filed with the Secretary of State. The capital stock of the new company is $1,600,000. The road will be 80 miles long, and will run through St. Joseph, La Porte, Starke, Porter, Jasper, Lake and Newton Counties, Indiana.

A New California Road.—A late dispatch from San Francisco says: "Articles of incorporation were filed yesterday by the Loma Prieta Company to construct and operate a single track narrow-gauge railroad in Santa Cruz County, commencing at Aptos, running northerly along Aptos Creek three miles, thence to White's Lagoon two miles. The capital stock is $50,000, divided into 500 shares.

A Road Completed.—The long-talked-of railroad route from Pennsylvania to the New England States is completed. On last Saturday the work was finished by the connection of the rails between Franklin Furnace and Andover, on the Lehigh & Hudson River line. Immediately after this work a train passed over the route from Greycourt, on the Erie, to Belvidere, on the Belvidere division of the Pennsylvania Railroad. From Belvidere the route runs northward through Warren and Sussex counties, crossing the Delaware, Lackawanna & Western, near Bridgeville, and the Sussex Railroad at Andover. At Franklin Furnace it crosses again the Sussex Railroad and the New Jersey Midland, and passes through the Warwick Valley to Greycourt, there forming a connection with the Newburg branch of the Erie Railroad. At Newburg the cars are ferried over the Hudson to the New England Road. To what extent the Pennsylvania Railroad Company will feed the new line is not yet known, but the officers of the Lehigh & Hudson claim that their road will have all the business it can carry from the Pennsylvania corporation. The rolling-stock of the new road is ready. The passenger coaches are very handsome and comfortable. Four postal cars have been built and furnished with every modern convenience for handling the mails. In a few days regular trains will be running over the route.

Railways and the Public.—Taking an average calculated for the whole country, a railway passenger, when he pays $1 for his fare, contributes 15 cents of that amount to the stockholders, 20 cents to the bondholders, and 65 cents towards paying the cost of operating the roads, the latter being distributed directly or indirectly, chiefly for wages to working people. These are the figures for all the roads in the country, taking the aggregates for dividends, interest payments and operating expenses. Of course, on some roads the whole of the dollar goes to the working mechanics, laborers, conductors, engineers and other employees, the stockholders getting nothing. The dollar, or a large part of it is, moreover, quickly returned to the shopkeepers of the country, for there are over a million and a half of railroad employees withdrawn from productive labor, whose wages pass regularly into the hands of the farmers and manufacturers who supply them with the necessaries of life. There are a good many different ways of looking at railroads and railroad corporations, and this is one of the ways in which they appear to be not black as they are usually painted.—*Phila. Public Ledger.*

A New Chicago Railroad Company.—Articles of incorporation have been filed with the secretary of state by the Chicago Suburban Railway Company, which proposes to construct a railway from a point near Galewood, on the Milwaukee & St. Paul, through Jefferson to Norwood Park, thence through Niles to the North branch, and thence along the river to the Pacific division of the St. Paul road in Chicago. The capital stock is to be $100,000.

Progress on a Pennsylvania Road.—The building of the Nazareth extension of the Bangor and Portland Railroad is greatly retarded by the track-layers leaving the work to go into the harvest fields. It is expected the rails will be laid to Nazareth by the middle of August.

The Canadian Pacific.—Grading has again commenced on the Southwestern branch of the Canadian Pacific. Four thousand men and two thousand teams are at work on the road west, and construction has reached 116 miles west of Brandon station. The Air Line has again suffered by rain storms.

An Extension Voted.—The Scioto Valley Railway Company has voted to extend the line from Columbus, O., to Fort Wayne, Ind., increasing its length from 150 to 300 miles. The capital stock was increased from $5,000,000 to $10,000,000, and a new mortgage authorized of $7,500,000.

The new monster engine of the Pennsylvania Railroad, called "Jumbo," weighs 120,400 pounds, or a little over 60 tons. The engine is so constructed as to run in either direction, and has a pilot on each end, thus doing away with the use of a turn-table. It is said to be the heaviest engine in the world, and with a train of 15 freight cars it made on a portion of the trial trip a mile in 59 seconds.

A Canadian Road.—The survey on the Kingston & Pembroke Railway between Madawaska and the Canada Pacific has been completed. The junction of the two roads will be effected four miles north of Renfrew instead of at Renfrew, as was formerly proposed.

The Gulf, Colorado & Santa Fé.—A large force of men are now engaged upon the line of the Gulf, Colorado & Santa Fé road between Snyder's Camp, three miles south of Lyons, on the main line, and Navasota, on the Texas Central, where connection is to be made with the Montgomery Central road, in operation from Navasota to Montgomery, which road is now the property of the Santa Fé. The grading forces between Snyder's and Navasota are working from both ends. The track of the Texas Western Narrow Gauge Railway has reached Sealy, on the line of the Gulf, Colorado & Santa Fé, and will soon be prepared for traffic—both freight and passenger—and will be operated in conjunction with the Gulf, Colorado & Santa Fe, thus affording the latter road another inlet into Houston.

St. Louis & Texas.—The St. Louis & Texas (N. G.) Railroad has been completed to the Mississippi River at Bird's Point. Trains will be run inside of ten days.

The Wisconsin, Iowa & Nebraska.—Work has been commenced on this road near the city of Waterloo, Iowa. Grading is also being done near Marshalltown, and, as the two forces are working toward each other, it is confidently expected that cars will be running from Marshalltown to Waterloo before the end of the year.

Suspension of Works.—A note from Mount Gilead, O., says: "The works, surveying and other, has been temporarily suspended by order of the officers of the New York, Pittsburgh & Chicago Railroad. The several corps of engineers have disbanded and gone home for a few weeks. The suspension is not caused by any embarrassment, but is only for the purpose of effecting a new organization and a letting of contracts for the entire completion of the balance of the proposed great East and West trunk line. It is probable that the next immediate branch of the road built will be from Marion through this city to Fredericktown, there connecting with the Baltimore & Ohio."

The Denver, Longmont & Northwestern Railway has let contract for an extension from Longmont west up Left Hand Cañon, Col., and work is begun; distance 15 miles.

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CONTRACTS LET.

Bridge Contract Let.—Commissioners of Logan County, O., awarded the construction of bridge No. 30, 62½ ft. on centers, to Massillon Bridge Co., at $15.90 per foot; also to same company, bridge No. 17, 140 ft. on centers, at $26.47 per ft. Both the above are through bridges, 16 ft. roadway, capacity 100 lbs. factor 4. Masonry for bridge No. 17. cost $6,000, awarded to James Nicoll, of Cleveland, O., at $11.90 per perch.

Bridge Contract Let.—Bids were opened by the commissioner of public works, of Chicago, for the work of constructing a bridge over the canal at Western avenue. The Massillon Bridge Company was the lowest bidder, offering to do the work for $5,000.

A Dock Contract Let.—The Chicago Dredging & Dock Company was the lowest bidder for the job of constructing the docks at the west pumping-works, offering to do it for $10 per lineal foot.

A Railroad Contract Let—Quebec, July 18—The contract to build the St. Charles branch of the Intercolonial Railway has been awarded to J. Hogan, which is simply another name for Hon. Mr. McGreevy, M.P. for Quebec West. Operations are to be commenced immediately.

Contract Let for Harbor Improvements.—The Harbor Commission of Quebec has awarded the tender for dredging to Mr. Askworth, and that for woodwork to Larkin, Connolly & Co., contractors for the graving dock.

San Francisco Contracts Let.—The Board of New City Hall Commissioners awarded the contract for the completion of internal work on the Larkin street wing, to J. K. Delmas, for $28,919. The contract for supplying Portland cement was awarded to Blochman & Cerf, at $4.60 a barrel, and the contract for supplying lime to H. J. Holmes & Co., at $2.10 a barrel.

A Toronto Street Paving Contract Let.—Tenders have been accepted by the Committee on Works for the construction of cedar block pavement on the whole line of Queen street, from the Don river on the east to the railway crossing at Parkdale on the west. In order to facilitate the work of construction it was deemed prudent to let the job out in sections, because it was supposed to be too great an undertaking for one contractor, with a prospect of completing the work within a reasonable time after the ground was broken. Consequently the work has been let to six different contractors.

School-House Contract Let.—Oskaloosa, Ia., has contracted for a new school house to cost $13,537.

Bridge Contract Let.—The contract for the new iron bridge in Stockbridge, Mass., near Glendale depot, has been awarded to the Corrugated Metal Company of East Berlin, Ct. It will be erected the first week in October and will cost $3,400 above the abutments. It will be 110 feet long, with a roadway of 16 feet and one sidewalk.

* * *

CONTRACTS.

Two Greenfield (Mass.) contractors, G. E. Lyons and A. H. Wright, have contracted to build the piers and abutments for the Connecticut River Railroad Company at Willimansett. Wright does the bridge work and Lyons the stone-work. The stone will be taken from the Dummerston quarry near Brattleboro, which was bought by Lyons some months ago. The cost of the work is estimated at about $40,000.

Messrs. Johnson & Wilson, manufacturers of Saylor's Portland Cement, have increased the capacity of their works to 8,000 barrels per month. They quote present market price of Saylor's at $2.30@$2.75.

* * *

BUILDING.

Town-Hall repairs at Easthampton, Mass, are being made at an expense of $5,000.

The Board of Directors of the City Infirmary of Cincinnati, O., will receive proposals until July 26 for the erection and completion of additions to the City Infirmary buildings, near Hartwell, O., in accordance with drawings and specifications prepared by E. Anderson, Architect and Superintendent, and now on file at the City Infirmary office.

New Depot.—The Denver & New Orleans Company has purchased ground for a depot at Pueblo, Col.

New Depot.—The Texas & Pacific Company have made arrangements to build a $20,000 passenger depot at Marshall, Tex.

A 100,000-bushel grain elevator is being erected in Jacksonville, Fla.

* * *

LABOR.

Labor in New Orleans.—Employers have agreed to pay 50 cents a day increase to first-class workmen in the trades, and a strike is thereby averted.

Wages in Canada.—A large gang of men have commenced construction on the Toronto & Ottawa Railway near the village of Orden. The wages paid are from $1.25 to $1.40 a day.

* * *

CONSTRUCTION.

A Ship-Yard at Bay Ridge.—The National Construction Company has purchased the Michael Bergen farm at Bay Ridge, comprising 26¼ acres, and having a water front of 700 ft. At the office of the company it was said that this property would be converted into a large ship-yard. All the buildings and machinery necessary for the construction of all kinds of vessels, from a yacht to a steamship, will be supplied. Two or three marine railways will be built. A number of piers and a breakwater will be constructed, and a safe basin provided. This company is allied to the American Rapid Transit Company, of Boston, which proposes to establish a line of fast steamships to run from Boston to Bristol, England. The construction company is now building, at Nyack, a small steamship of the new domed-deck pattern for the purpose of testing its capabilities, and if it proves as successful as its projectors hope, four large ocean steamships will be constructed on its model, to run between the ports above named.

* * *

BRIDGES.

The builders of the Kinzua Bridge, in Bradford County, Pennsylvania, are offering eight dollars a day for laborers on some parts of the work, and there is a scarcity of men even at that figure. Work is going on at the height of two hundred and eighteen feet, and before the bridge is finished men will have to work at a considerably greater altitude.

The New Bridge Across the Maumee.—Toledo, Ohio, July 15.—The large draw of the Wheeling and Lake Erie bridge across the Maumee was swung into position to-day, and was found to work smoothly. This is one of the important steps in completing and opening the western end of the road. The structure is three hundred and forty-three feet in length, and weighs, with its equipments, over three hundred tons. The bridge is three thousand feet in length, and will cost upwards of half a million dollars.

New Illinois Bridge.—The bridge at Lacon will be 900 feet in length.

A Canadian Bridge.—It is expected that by the 1st of October, 1884, the proposed bridge of the Atlantic & Northwestern Railway, from Lachine to Caughnawaga, will be an accomplished fact. The plans have been approved by the Dominion Government. A double track loop line is being constructed from the Mile End depot of the Canada Pacific Railway to the bridge, three miles of which has already been graded, and on which over 200 men are at work. The entire line, which covers seven miles, has been located, and nearly all the requisite land appropriated. Although the approach to the bridge from the proposed station on Jacques Cartier square is somewhat circuitous, still it is claimed that the route to New York and points in New England is considerably shorter by the Victoria Bridge. Connection will be made at Chambly by a road built by the Atlantic & North-Western Railway to connect with the South-Eastern Railway, affording a southern outlet to the Canadian Pacific Railway.

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MISCELLANEOUS.

Power of Modern Guns.—The enormous power of modern great guns is well indicated in the statement that the largest on board of the vessels of the British fleet now in Alexandria harbor is capable of throwing a projectile weighing 1,700 pounds at a velocity of over a mile in four seconds—equal to 27,213 tons of metal falling a distance of one foot on an object. It takes 870 pounds of powder to fire this shot at this velocity, so any one versed in the prices of steel and saltpetre can calculate the cost of every shot that these guns will throw. It will be found that every report will cost not very far from $1,000.

The Erie Basin Construction Company, of this city, has been incorporated. Capital, $600,000.

A French Prize.—The French Government has offered for the second time a prize of $10,000 for the invention of the most useful application of the voltaic pile. During five years this remains open to competitors.

PRACTICAL NOTES ON HYDROGRAPHIC SURVEYING FOR ENGINEERING PURPOSES.

WRITTEN FOR ENGINEERING NEWS BY A. C. ROTH, C. E., PORTLAND, ME.

If a survey of a harbor or river is to be made which shall form the basis for contemplated improvements, either by dredging, blasting or other means, it is essential that it should be reliable in every respect. All the data collected and shown on the map—the shore-lines, soundings, the obstructions to navigation, as bars, sunken ledges, bowlders, etc., should be located and delineated correctly, and guess work, too often resorted to, should never be allowed.

The value of such a survey depends entirely upon the accuracy of the soundings and their location, in reference to established known points or beach marks on shore; therefore *all* soundings are taken on ranges established for that purpose, and *each* sounding is located by intersection with transit instrument from suitable stations, as later described. It is the object of these notes to show how such a survey is made in a satisfactory manner, containing results which have been accumulating during many years of service in this class of work.

The method, which we shall call the Fan system, has proved itself, by judicious management, extremely flexible in adaptation to the ever-varying localities; it offers many advantages and fulfils the requirements of such a survey better than any of the numerous methods generally employed. In tidal rivers and harbors, mean low water is usually adopted as the plane of reference, and if not already known, we have to establish this important part of the work at once.

A tide-gauge, clearly marked in feet and tenths of feet, is securely fastened at some place convenient for observations, where the water-surface is sheltered from wind and waves. The zero of this gauge should be below the lowest low water, and the gauge long enough to project above the highest tides. It should be referred by level, *at once*, to a distinct mark on one or more objects, not likely to be removed or demolished. A sketch of the location of these marks should be made, and their elevations above the zero of the gauge recorded. Observations of the high and low waters are at once begun, and continued day and night for one lunation (29 days) at least. The observer, who must be thoroughly trustworthy, should record from 3 to 5 tenths of rise and fall (or vice versa) before and after every high and low water, note the time, and also keep a record of the force and direction of the wind.

From these observations the mean high and low water levels are deduced, and the reference of the bench-mark corrected accordingly. This work should be closely watched by the chief of party, who should also personally look to the correct establishment of the bench-marks, the most important part of the work.

Next we select a suitable place for measuring a base-line. If, as often happens, this line will have to be measured some distance from shore, it is not necessary or desirable to preserve it; but, instead, two of the triangulation points, which can or must be permanently marked, and from which as many of the other triangulation points as possible can be seen, are used for bases. The distance between them is determined by triangulation. The line should be measured twice, as accurately as possible, with a standard steel tape, making the proper allowances for difference in temperature. If the ground on which the line is measured is not practically level, the elevations of all the stakes used must be determined by leveling, and the line reduced to the horizontal. Select a cloudy day for this work (the measuring of the line), on which the difference between the temperatures of the air and the ground, upon which the tape will rest more or less, are more nearly alike than on a hot, sunny day.

The establishment of all the triangulation points, which is next in order, should be done in such a manner that they will answer another purpose also, which will be explained forthwith. As far as triangulation is concerned, they should be such distances apart as to give good intersections (not less than 30'), command a fair view upon the water, and to as many other triangulation points as possible, and be near enough to each other, so that the intervening shore-line, etc., can be reached easily and connected by telemetric measurements from the adjacent stations. That some of these points should answer the second requirements, viz: as centers of convergence for a number of ranges for soundings, they must be located at places where an open space or clearing (behind or in front) will make this possible. All the triangulation points should be established at once and marked permanently if possible. A drill-hole in a ledge or some small boulder sunk in the ground for the purpose is best. For want of either, a copper nail in a good stake, driven a little below the surface of the ground, must do. Erect at once small signals over them, large enough only to be distinctly seen with the instrument; they will save a great deal of time and vexation during triangulation. Have a number of the signals made beforehand, from one inch square stuff, two to four feet long, painted red. To a crosspiece on top tack a piece of cotton cloth a foot square, and fasten the lower edge with a few tacks to the upright; it will keep the flag spread. Should small braces be needed (for signals over stakes) use cord instead of nails, so that they can be taken down and put up in a moment. The stations are designated on one side of the harbor or river by Roman figures, on the other by letters, and they should be marked in the field accordingly with good paint—it prevents mistakes. A small rough sketch should be made during this work, showing location and describing the nature of the station, whether drill-hole in ledge or boulder, stake, etc. After completion of this work we are thoroughly acquainted with the shore lines and appearance of things generally. We are ready now to commence the triangulation. It is advisable from the start to do this work diligently without hurry; it pays at the end and saves time. To find that a mistake has been made in an angle at any one station is extremely aggravating when discovered in plotting the triangulation. From the station occupied angles to all visible stations should be taken (they give a good check upon the work) including the bearing of the magnetic needle, with reference to the zero of instrument. A good number of prominent fixed objects on shore, church steeples, tall chimneys, cupolas, or chimneys of isolated buildings, lighthouses, buoys, etc., should be included in the triangulation; they are, as we shall see later, very useful as backranges in case of emergency, for indicating sailing courses, and for other purposes.

The instrument, during this work, should be carefully protected from the sun's rays by a large umbrella. In larger surveys using a transit reading to single minutes only, the angles should be repeated twice or four times. It consumes much time, but assures greater precision and detects mistakes at once. We come now to a part of the work which is as disagreeable as it is essential to a good systematic hydrographic survey. This is the plotting at night (generally by poor illumination) of the work done during the day. At least a rough plot of the triangulation points must be made now. We shall need it many times daily during the entire survey. We can now lay out upon this sheet, with a protractor, range-lines for sounding, radiating from suitable triangulation stations in the shape of fans. The last range of each fan is the first range in the next one, having its centre on the opposite shore. The whole area to be surveyed is thus covered evenly and as closely as deemed necessary. If later soundings, taken on these *general* lines, indicate any shoals, ledges or other obstructions which need further investigation, more ranges can be interpolated to cover those questionable places and soundings taken as close as desired.

The bearings of the ranges thus laid out on the sheet are noted and established in the field accordingly. Stakes marked to correspond with the numbers of the range lines on the map are driven for this purpose far enough from the station to give quick acting ranges, that is, they should show any reasonable deviation from the line at once to the leadsman. A nail should be driven in each stake to indicate the line exactly. It is not necessary to lay out all the ranges at once; there will be chances enough to keep them ahead of the sounding. It will be seen that thus all the range-lines are laid out from triangulation stations only, and that they can be re-established without any trouble and in a short time, providing proper care has been taken to mark these comparatively few points permanently in the first place. Sometimes it happens that certain areas cannot well be reached by these fan ranges, in which case it is an easy matter to fill such gaps by ranges running from one to another of the numerous telemeter stations later to be established. For the work done so far, only three men were employed beside the chief. The duties of these three men in future should be those of leadsman, boatman, and signalman, as they have to be and are, by this time thoroughly acquainted with all the triangulation points and ranges, etc. In order that they may be qualified to perform these functions, care must be exercised in their election. The boatman, and especially the leadsman, should be entirely trustworthy and intelligent men.

For sounding, the boat crew consists of leadsman, one boatman (except in quick water and extensive surveys, when two are employed) and a recorder.

Beside, we need the signalman who attends to the shifting of the range-poles, and a tide-observer. The latter commences work at a stipulated time and continues until the boat-crew returns. In most cases the observer, already employed (for observing the high and low waters) is willing, for an increase of pay, to take the tide while sounding is going on. He takes the rise and fall of the tide for every tenth of a foot, and notes the exact time.

To the signalman should be given a memorandum stating the numbers of range-lines in the succession they are to be sounded, and he should check the number of each range as soon as sounding is completed. He should set up the range-poles plumb and exactly on line. The completion of sounding a line is indicated to him by the leadsman, who waves the flag in a half circle, until he sees one of the range-poles taken down. If the range-stakes are far enough apart, so that no confusion will occur by erecting the range-pole for the next line, while one is sounded, he should invariably do so, as much time is saved by it. The duties of the recorder are as follows: Before commencing to sound a line, he should hold up a flag, to indicate that everything is ready. Upon the return only of this signal by the observer, sounding may commence. He notes and numbers the soundings as given to him by the leadsman, and at every 5th, 10th, 15th, etc. sounding—a moment before it is to be taken—he raises his flag for a few moments. These signals are not answered, but noted by the observer. They only serve as a check upon the work. Should at any time one or more angles be missed, by reason of passing or anchored vessels obstructing the view of the observer, or a sounding is forgotten to be recorded, such discrepancies can be remedied inside of five soundings, and the line need not be condemned as doubtful. He should also closely watch the observer, who regulates by signals, especially at the start, the distances between soundings. Raising both arms above the head, or extending them horizontally, are the signals we use to indicate "nearer together," or "further apart." Upon seeing one or the other, he should inform the boatman at once.

If the man we have engaged as boatman turns out to be such, we can consider ourselves lucky. To pull a boat for sounding is by no means done as easily as it appears, and unless it is in the man naturally, you seldom can teach it to him. A good boatman will handle a boat under the constantly varying conditions of currents and winds as gracefully as a swan handles itself; he will stop the boat at regular intervals on the line, and keep it there long enough to have the sounding taken. He is the man, by whose good work time and money and an enormous amount of vexation is saved. In the first place the boat is pulled the distance the soundings are desired to be apart; arrived at this point, the stern of the boat, where the leadsman stands, should be *on range*, and the boat be at a stand-still. Both boat and leadsman watch the ranges sharply, and should the boat not be on line exactly, the leadsman gives the final directions. After a little practice, a good boatman will not only do this whole operation quickly, but will also do it easily. By taking into proper account—and advantage of—the wind, or the current, or both, sounding can be carried on when a less experienced boatman could not keep a boat anywhere. In still water, and without wind, of course, the boat can be pulled direct on the range, and stopped there for each sounding, without shearing off and on the range, scallop fashion.

The leadsman's duties may be summarized as follows: First, he should never take a sounding unless it is exactly on range; second, always take plumb soundings, and third, should read off the soundings correctly. Besides these principal points there are others which are very essential, in fact, necessary to do good work. All his movements should be as regular as clock-work, and alike for each sounding; it helps the observer very much to know by these movements, especially when the boat is a mile or two away, when a sounding is to be taken. The leadsman occupies the stern of the boat, left foot down, the right foot on the seat. When nearly on the range he lets his sounding lead run to the bottom. The moment he is on the line, he squats down on his right foot, and takes hold of the lead-line at the water's edge (holding the line taut with the left hand). This done, he immediately lifts his left arm over his head for a few seconds. This signal, and the intersecting, by the observer, of the leadsman's right hand is simultaneous. He then stands erect, reads off the sounding from where his right hand has hold of the line, and calls it to the recorder, who should repeat it. He should also frequently give the nature of the bottom as soft, sticky, hard, rocky, solid ledge, etc. In taking soundings very close together, the lead is not hauled in at every sounding. The leadsman especially should also watch that the distances between soundings are regular.

Having gone through the routine work, to be performed by every member of the crew, it remains to be seen what the chief of the party has to do. It may be mentioned here, first as well as last, that his duties are manifold, and will require every moment of his time, day as well as evening, if he intends to be always ready and make the best use of the time and the weather. Having completed the plotting of the triangulation and decided upon and laid out on the map the general system of ranges, also located a sufficient number of them in the field to be ready for sounding, a list of all the ranges should be made out (in the back part of the angle book, for immediate reference), headed with notes showing from which triangulation stations the several fans of ranges, or parts thereof, are to be intersected; also what stations shall be used for zero of instrument.

Close in shore, where the range-lines converge closer and closer, it is useless to sound them all.

We therefore take soundings to the shore on every second, third and fourth, etc., line only (to be determined on the map), and limit the others in such a manner that the soundings will be about equal distances apart. These limit angles are noted behind the respective numbers of ranges in the list. Later we probably shall need limit angles (two for each line) for sounding on interpolated ranges, to cover shoals, sunken ledges, or other obstructions, which will require special surveys. This list should be announced every night, as the work progresses, so as to give quite a choice of ranges to select from. It will be found that frequently the programme for work, made up at night, must be changed the next morning in the field, on account of the wind and weather. In such emergencies this table is of the greatest value; from it we can select such work which can be done favorably under the prevailing circumstances, and many hours, otherwise lost, are utilized during a survey.

All the men being properly instructed in their respective duties, and sent to where sounding is to be commenced, the tide observer's watch compared, we will see how everything works together.

The signalman erects the front or back range (the centre range, as the case may be) plumb and braces it, if necessary, so that it may not tumble over during sounding; then he sets up his other range at the stake, called for in the memorandum. Meanwhile, the observer has occupied the station given in his table as intersecting station for these lines. Having levelled the instrument and pointed its zero on the proper point, and being otherwise ready, he waves his flag to the recorder. The boat being on range (near shore), the recorder returns this signal, and sounding commences. All the soundings are now intersected by the observer; every full minute of time is noted behind the sounding taken at that time, from a timepiece placed conveniently on the instrument. The recorder's signals, indicating every 5th, 10th, 15th, etc., sounding, should correspond with the same number of angles taken; if not, at any time, correct at next flag. If the distance between soundings does not agree approximately, at least with that given to the leadsman, the observer gives the signal "nearer" or "wider" apart to the recorder, who is watching him between noting the soundings, and informs the boat and leadsman at once to that effect.

The known length of the boat serves here as a guide. If all works satisfactorily, and the boat and leadsman understand their business, lively work is in store for the observer.

He will have little time left to contemplate upon his lame back, generally the result of the first few days' work. With a new crew, nine times out of ten, the first few lines or a forenoon's work will have to be done over again, and here, patience is recommended. If the men are smart, it will go well from the start and better at every line. Insist from the first, that the boat is brought to a standstill at each sounding, that the leadsman is careful to get plumb soundings and *always* at each sounding lift his left arm determinedly above his head, also that the recorder shows his flag as instructed. The men are apt to grow slack in these things unless kept to it from the beginning. As soon as sounding a line is completed, the leadsman waves his flag; the signal man changes his range-pole, and the new line is sounded on the return trip. If lines are short and soundings are to be close together, as in detail surveys of ledges or small shoals, for instance, the soundings can be taken at more regular intervals, by beginning them all on one side, working against wind and current, if possible. With an experienced crew in *general* sounding, 4 to 8 soundings, and in special surveys, where soundings are from 2 to 5 feet apart only, up to 10 soundings per minute can be taken. The latter number, however, is a maximum attained only by long practice, as more than ten angles cannot well be taken, read, recorded and the time noted in less than a minute. Soundings should now be done at every possible chance, and when this is impracticable on account of high wind, strong tides, etc., the shoreline survey is fallen back on, to fill out the time. For this purpose it is well to *always* carry the telemetric and other necessary tools along in the boat, so that whenever sounding has to be discontinued (mostly on account of strong winds) this work can be taken in hand at once.

Shield the instrument with the large umbrella from the wind, and the telemetric work can be done as well, even better, than on a fine sunny day, when the motion of the heated air makes reading from telemeter difficult and uncertain.

It is advisable not to be stingy in the shore line survey; but sight at all objects, possibly of any use in future. All houses within easy reach of the telemeter, wharves, fences—all projecting points, isolated trees, the bench-marks and location of tidestaffs should be taken, and whenever possible, these telemeter stations should be marked by a small cross and running numbers (between each two triangulation stations) with good (red lead) paint. All these points tend to make up a complete and accurate map of the survey, and may come very handy at some future time. At triangulation stations, which are likely to be occupied but once (when triangulating), it saves time to complete the telemeter work at that time. To avoid the great annoyance caused by the reflex of the sun on the water—often so blinding that the ranges cannot be seen from the boat—we must arrange our work so that the ranges for lines to be sounded in the forenoon are on the north or west shore of the water sheet, and those for the afternoon's work on the east or south shore. It is impossible here to mention the many ways which can be made available to nicely cover a certain area with range lines. Suffice it to say, that however badly the chances for fan-ranges look at first, a discriminating eye and good judgment will find them before the triangulation is completed. Very rarely, however, we may be obliged to use for back ranges suitable points of our triangulation, back from shore, such as chimneys or corners of buildings, steeples, isolated trees, etc. In such a case a nice pair of ranges is established by locating the front ranges along a straight line between two known points by measurement, or by using the telemeter stations along the high-water line direct.

If the special purpose for which the survey is made is known, which is most always the case, the character of the bottom at such places where improvements are projected should be examined by borings, otherwise they should be made generally over the area covered by the survey.

The velocities of the currents should be determined at least approximately, unless for *some* special purpose they are required to be minute.

Having thus given a general sketch of the field work, a few words in regard to plotting the work may not be out of place here.

We suppose the triangulation has been plotted and the ranges laid down, numbered and the limits for sounding (if such are necessary) marked and noted. Through this work alone we are assured that we shall cover the ground satisfactorily with soundings, even if they are not plotted at the time. In order, however, to get a general idea of the bottom, it is to be recommended to plot a few lines of soundings, at least, of each day's work. It is very essential to glance over the soundings after each day's work. Plot and reduce (to an approximate plane of low water, if the true plane of reference is not yet known) those soundings which indicate shoals dangerous to or obstructing navigation.

Should closer investigation of such shoals be deemed necessary, we interpolate a few more ranges at either side of the supposed shoal, and sound only those portions of these lines as are believed to cover the same. Should closer soundings be required we repeat the same operation, developing thereby the characteristics and limits of such shoals to any degree of accuracy. The soundings are thus taken only where necessary and much time is saved. These especial surveys are carried to such an extent that accurate estimates as to quantity and quality of work can be made of them. It is advisable to plot a survey to such an extent (in the field) at least, as to give positive assurance that every doubtful point is satisfactorily covered, a work which can be done in a few hours every evening. We have plotted *all* the work in the field for years, but, however, great the satisfaction of bringing home a complete field-sheet of survey, have come to the conclusion that this is impracticable and the continuous night work highly injurious to the eyes.

Before concluding we would call attention to the instruments and tools proved to be most convenient. The transit (for intersecting soundings) should have one vernier only (under the eye-piece of the telescope) so that angles can be read *very* *quickly.* The graduation should be coarse enough to be easily read with the naked eye. It should be fitted with horizontal cross-hairs (adjustable if possible) for using the telemeter, a most valuable requisite in hydrographic surveys. For the constantly varying line a sounding *chain* has been substituted. We use brass jack-chain, No. 12 wire; the ends in each link being nicely soldered before using. The lead should weigh from 8½ to 12 pounds. Seven or eight fathoms of chain are sufficient for most work. For deeper water a piece of codline may be spliced to it. It is marked as follows:

1 fathom, a piece of red flannel.
2 fathoms, a piece of white flannel.
3 fathoms, a piece of blue flannel.
4 fathoms, a large leather tag with one hole.
5 fathoms, a piece of red flannel.
6 fathoms, a piece of white flannel.
7 fathoms, a piece of blue flannel
8 fathoms, a large leather tag with two holes.

Each foot is marked by a leather strip 3/16 in. wide, about 4 in. long. To attach them, so that they will not work out during sounding, which they will do otherwise and cause annoyance and delay, cut a slit about 1⅛ in. long (button hole shaped) into one end; stick this end through the respective link of the chain, and then at once through the slit—far enough to pull the long end through the slit in this projecting end. This fastening will hold as long as the leather lasts. A sounding pole, needed for closely surveying sunken ledges, can be quickly made as follows: Into a planed seasoned spruce pole, insert a ⅜ inch round steel rod from 4 to 6 feet long, having a collar weld on about 8 inches from the end; drive this into the double iron banded end, and mark the feet and tenths on the pole (having one side flattened for this purpose as well as to enable the leadsman to feel where the marks are and keep them towards himself while watching the range poles). The marks are burnt in with hot iron. Three irons will do, which will burn marks as follows: 1″ = 1/16″ — ½″ = 3/16″ and one a half circle about ½″ outer and 7/16″ inner diameter. All numbers (Arabian are best) and other marks are nicely and quickly burned with these: they show well and do not wear. The middle of the number indicates the foot mark, the tenths are marked ⅜″ long and the half foot marks by a circle. Next we want three range-poles. They are made of well seasoned pine 4½″ = 2″ at bottom, 3″ = 1 at the top, oval shaped, and are 12 ft. long, with substantial iron shoes at lower ends; they are painted alternately every 3 ft., bright red and white. For long distances light triangular frames (5 ft. sides) covered or stretched with red or white bunting, are screwed to the poles, point up on one and down on the other range-pole. Two black and white flags about a yard square, with light handles 4½ to 5 ft. long, are needed, one for the recorder (or leadsman) the other for the observer. The boat should be about 45 ft. long, be wide enough to be stiff, have a wide stern and little if any keel, so that it may be easily handled in quick water and especially in turning. A hatchet-saw, some stone drills and hammer, a small pointed crowbar, and a pot of red-lead paint and marking brush, completes the list of tools. For measuring base-lines we use a 200 ft. standard steel tape, for detail measurements a 50 ft. steel tape. A leveling instrument and rod, a couple of surveyor's poles and a telemeter, of course, are included in the outfit.

The advantages of this system of surveying will be still more apparent, when it comes to laying out work, especially for dredging operations.

After the location of the channel is decided upon and drawn upon the map, we can establish longitudinal ranges for guiding the dredging machines. The distance which these ranges are apart, depends upon the width the dredging machine can cut; as one set of ranges only is needed for two adjacent cuts (the port side of dredge being kept on the range for one cut, and the starboard side on the same range for the next cut), the distance between these ranges is twice the width of the cut the dredge can make. The daily progress of the dredge is exactly determined by side-ranges, crossing the channel at angles not less than 30°; these ranges are established from suitable triangulation stations, and generally the ranges formerly used for sounding can be re-established for this purpose. In cases where longitudinal ranges cannot be established on shore, guide-piles are driven at suitable places, and signals fastened to them. For curved channels and places where dense fogs prevail a good part of the time, we use piles driven about 200 feet apart, and about 10 to 15 feet from the edge of the channel; they are numbered to correspond with the plan. A fine wire rope (seven thread) is stretched from one pile to the other, and the dredge's bow—for the several cuts—is kept parallel to this wire rope by means of a marked line attached to this wire rope by means of a snatch block. Dredging can be minutely reported and followed up at headquarters as well as on board the dredge. The amounts dredged can be checked at any time by transferring the progress made on the estimate sheet, and then calculating the amounts contained in the areas dredged over. A so-called progress-sheet, showing all the longitudinal, as well as the side ranges, is kept on board the dredge. The progress for each day is marked on this, and, being reported to head-quarters, is there marked in the same way on a copy of that progress-sheet. The report states simply the number of the cut and the distance of bow of dredge above or below the respective side range. Much more could be said regarding small details; these, however, will suggest themselves. Trusting that these notes will give some acceptable hints to those about to make a hydrographic survey, I hope I have not encroached upon your valuable space too much already.

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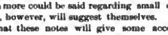
A NEW DRILL.



The drill of which the above is a cut, is manufactured by the Chicopee Machine Company, Chicopee, Mass. The length is 15 in. with ⅜ steel drill. The spindle has right and left double grooves with two right and left banded nuts to match the same. The outer edges of the nuts have ratchet teeth to clutch with corresponding teeth upon the inner faces of the slide, and these nuts thus enclosed between the ends have sufficient space left between them to enable one to be disengaged, while the other is clutched fast to the slide. So that, when the slide is moved, one nut becomes part of the slide to impart motion to the drill, while the other is free to follow within the slide upon the stem. So whichever way the slide is moved, the drill runs in the same direction. The drill was patented April 19, 1881. The chuck is made of steel and is a new device for which a patent has just been allowed. It holds a drill from 1/16 to 5/16 in., and can be used for either metal or wood.

SANITARY INSTITUTE OF GREAT BRITAIN.

The following were the papers set at the fall examination held by this Institute for surveyors and inspectors of nuisances. They will doubtless be of interest to many of our readers :—

Examination of Surveyors.

PAPER 1.—2 TO 4 P.M.

1. State the principal provisions of the Public Health Act of 1875. Is it applicable to the whole country? Has it been modified by subsequent legislation, and if so, how?
2. Give the substance of the model by-laws issued by the Local Government Board, regulating the construction and management of slaughter houses.
3. A 12-in. pipe sewer is running half full, and the sewage has a velocity of three feet per second; how many gallons will be discharged per minute? Also, how many gallons per minute will be discharged from a 6-in. pipe drain under the same conditions? Give your calculations in full.
4. Describe and give a sketch of the form of man-hole which you consider best adapted for ordinary town sewers, and state the rule which you adopt for determining the amount of ventilation to be afforded in a main street sewer.
5. Describe (with diagram) three typical forms of disconnecting traps for drains, and explain their action.
6. What are the chief points to be looked at in order to determine whether a water-closet is satisfactory from a sanitary point of view? Illustrate your answer by sketches.

PAPER 2.—6 TO 8 P.M.

1. What is an artesian well? Under what circumstances would you advise the construction of such a well?
2. How is drinking water most likely to become polluted—(*a*) in a town with a public water supply? or (*b*) in a rural district? What precautions would you take in each case to prevent the pollution?
3. What circumstances favor the entrance of "ground air" into a building? Why is it necessary to exclude it, and what are the principal modes of doing so?
4. Give a clear and concise definition of good ventilation, stating how much air is required per head per hour.
5. Sketch plan and section of a hospital ward and its offices for twelve patients and state how you would proprose to ventilate it.
6. Sketch sections of roadways constructed of different materials, and state the advantages and disadvantages of each.

Examination of Inspectors of Nuisances.

4 TO 6 P.M.

1. What diseases are considered infectious? What is the law with reference to the exposure of persons affected with infectious diseases.
2. What are the provisions of the Public Health Act of 1875 with regard to cellar dwellings?
3. Why is ventilation necessary? What is the greatest number of people that should be allowed to sleep in a dormitory 20ft. by 15ft. by 12ft high?
4. Under what cirumstances is it necessary to have butts or cisterns for the storage of drinking water, of what materials are they usually made, and in what ways may the water in them become contaminated?
5. What are the relative advantages of pipe and brick drains? What do you consider the least fall that a house drain should have?
6. What are the most important points to be observed in inspecting a cow shed?
7. You are sent for to a house where there is a case of small-pox. What steps would you take?
8. If you are refused entrance into premises where you have reason to believe that a nuisance exists, what would you do?—*Contract Journal.*

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DISCREDITABLE DIPLOMACY.

[From the London Shipping and Merchant Gazette.]

The gigantic castrophe which has overwhelmed Alexandria, and consigned its Grand Square and most of its business quarters to the flames is a melancholy culmination of a long and rather discreditable diplomatic history. Arabi ought long ago to have been suppressed. The impotence of Europe, and the miserable jealousy of France in particular, prevented him from being put down, and the consequence is that he has ruined all the trade in Egypt and destroyed Alexandria. This is the result of modern diplomacy, and in the light of the flames of the chief port of Egypt we must say that we prefer the ancient kind which would have put an end before now to a man who could have been dealt with three months ago by a single regiment of soldiers. What he has done in Egypt is simply this—he has brought the whole State into a chaotic condition of anarchy. Since 1860 the crops have been trebled. European capital has redeemed vast tracts of waste land; it has furnished the natives with loans on easy terms; it has purchased steam pumping machinery for irrigating purposes; it has erected cotton-gin factories and steam presses, and it has established means of communication between the producer and the export ports. All this goodly edifice has been brought to the ground by Arabi. The producer can neither sell his goods nor pay his laborers. Since the commencement of the troubles usurious rates have been charged for loans. The steam machinery is useless, because its owners cannot buy coal. Mr. John Slagg points out that the cotton seed which was formerly burned in both houses and ovens, and even thrown away, is now exported to the value of £2,000,000 per annum. Ninety per cent. of it comes to England. In 1881 no less than 120,000 tons came to Hull alone, and 2,300 men and boys were employed in crushing it. The farmers who buy this cotton cake for feeding purposes will now be compelled to pay higher prices for the limited quantity reaching our markets, and a large number of people in this country will be thrown out of occupation. The soap boilers, who obtain 50,000 tons of oil from the same product, will also suffer. About 70 per cent. of the 1,000,000 quarters of wheat annually exported from Egypt comes to England, and so do about 80,000 tons of sugar. These and the 200,000,000 pounds weight of cotton which we annually obtain from the same source can no doubt be obtained elsewhere, but Egypt took in return for them manufactured goods, machinery, coal and cotton goods, and all of these interests must suffer more or less from the ruin which has overwhelmed Egypt.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, JULY 29, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.

COLORADO MEETING.

Programme.

Saturday, Aug 19—In Denver. A brief preliminary evening meeting, at which the Institute will be received by the citizens of Denver.

Monday, Aug. 21—Visit to Black Hawk and Central, with an evening session at Central City.

Tuesday, Aug. 22—Georgetown. Idaho Springs. Return to Denver in the evening.

Wednesday, Aug. 23—Leadville, going over the South Park Railroad. Evening session.

Thursday, Aug. 24—Excursions to the Leadville mines.

Friday, Aug. 25—Excursions to the Leadville smelting works, reaching Pueblo at night.

Saturday, Aug. 26—Pueblo Iron and Steel Works, and Mather & Geist's Smelting Works. Colorado Springs and Manitou in the evening.

Sunday, Aug. 27—Colorado Springs and Manitou.

Monday, Aug 28—Return to Denver. Evening reception.

Tuesday, Aug. 29—Argo Smelting Works. Golden and its smelting works. Subscription dinner.

Besides these excursions, facilities will be afforded those who desire to see the iron and coal mines of Colorado. And for those who can extend their visit, an excursion to the San Juan district will be organized.

Arrangements are being made with the railroad companies for reduced rates to members of the Institute and ladies accompanying them. When concluded, a circular will be issued informing members of the expenses from different points to Denver and return. These rates will probably not exceed two-thirds the regular rates, or about $60, plus Pullman car special rates, from New York to Denver and return. Special facilities are courteously offered by the roads in Colorado for the excursions of the Institute.

Persons proposed for membership have the same privileges as members with regard to the meeting and excursions.

As usual at the meetings of the Institute, ladies are expected to be present. Seventy-seven members with forty-three ladies have already signified their intention of being present at the Colorado Meeting, and it is expected that the attendance will greatly exceed these numbers.

The unusual attractions offered by the mining regions of Colorado are increased at this time by those of the Denver Exposition of mining appliances, minerals, etc., and by the unusual facilities offered for examining mines and works, and acquiring information concerning them.

The representatives of several foreign kindred societies are expected to be present.

Members who purpose attending this most interesting meeting should at once write the secretary of the Institute, who has to notify the railroad companies of the number of tickets required, and the names of those entitled to the special rates offered. They are also requested to inform the secretary promptly of their intention to read papers at the meeting.

Prof. W. I. Marshall, who is well known by his lectures on the wonders of the Geyser Country, offers to conduct a party of not less than eight, nor more than twenty-five, through the Yellowstone National Park. This trip would occupy from twenty-six to twenty-nine days from Denver to and through the Park and back to Denver. The greater part of this time would be spent "camping out" in the Park. The expenses of this round trip are estimated at from $275 to $300 for each person. Full information concerning this trip may be obtained from Prof. W. I. Marshall, Fitchburg, Mass.

R. P. ROTHWELL, President,
27 Park Place, New York City.

T. M. DROWN, Secretary,
Easton, Penn.

THE RIVER AND HARBOR APPROPRIATION bill, as amended by the last Committee on Conference and finally passed by both Houses of Congress, appropriates $18,743,875.

TORONTO, Canada, is expending a large amount of money this season on public improvements. Besides the street-paving noticed elsewhere, several sewers are in process of construction and more are being planned. They and all roadways are built on the frontage tax system. Laborers' wages are $1.25 to $1.50 per day; bricklayers get $2.75.

THE *North American Manufacturer*, of Philadelphia, commences its fourth volume, new series, under the new title of *Iron*. New talent has been engaged in the various departments of the paper, and the general typographical appearance much improved. There are 16 pages of wide three-column measure, containing able articles on pertinent subjects and full market reports from the leading manufacturing centres. We wish unbounded success for our contemporary.

In the June transactions of the American Society of Civil Engineers A. G. Menocal has a paper in Sub-Aqueous Underpinning, and R. E. McMath has a paper on The Mean Velocity of Streams Flowing in Natural Channels. Both papers are very fully illustrated. The additions to the Society membership published: are, Members; Wm. H. Bixby, Lieutenant of Engineers, U. S., Willets Point, N. Y.; Wm. G. Curtis, Superintendent of Track Central Pacific Railroad, San Francisco, Cal.; Thomas Doane, Consulting Engineer, Charlestown, Mass.; Edmund L. B. Gardiner, Engineer Dundee Water Power and Land Company, Passaic, N. J.; Edward H. Keating, City Engineer Halifax, N. S. Associate; Ashbel Welch, Jr., Proprietor Lambertville Iron Works, Lambertville, N. J. Junior; John R. Freeman, Prin. Assistant Engineer Essex Water Power Company, Lawrence, Mass.

CHEAP MOTIVE POWER.

Storage batteries and their great possibilities are turning attention to cheap motive power. A paper, by Alfred R. Wolff, M. E., on the economy of the wind-mill, was read before the American Society of Mechanical Engineers, April, 1882. This able article has been reproduced in the Journal of the Franklin Institute and in some other periodicals. In it Mr. Wolff asserts that the wind-mill "is the most economical prime-mover for the purposes for which it is designed." As other able engineers frequently state that wind is our cheapest motive power, it might serve a good purpose to show that they are in error.

Upon the Danube, the Adige and other swift rivers of Europe, hundreds of water-mills or current-motors are employed, and for purposes which the wind-mill is nowhere attempting. These current moters are much more economical than wind-mills *for any purpose*, for the simple reason that a good current of water is much more powerful than any current of wind that can be obtained. A man may be upset by the force of a bucket-full of water, but who was ever knocked down by a bucket-full of wind.

The pressure of a wind of 20 miles an hour is only 2 *lbs. to the square foot*, while a 5-mile current is 54 *lbs.* (the pressure in lbs. per sq. ft. = the square of the velocity in feet per second). Thus water at 5 miles per hour has 27 times the pressure, and will yield about 7 times the power of wind at 20 miles an hour (the wind having an advantage of 4 to 1 in velocity). But we must multiply 7 by 3, because the current runs 24 hours per day, while the wind only averages 8. But in point of fact this *average* 8 is to most users worth less than a *regular* 4 hours—for reasons unnecessary to enumerate.

It is hard to believe, but easy to prove, that there are many points in the United States where current-motors would produce from 10 to 40 times the power of the most favorably-located wind-mill of the same size. There are many towns on swift streams which could quickly double their population and the value of their property by utilizing for manufacturing purposes the river rolling at their feet. These are enormous facts which should receive attention.

Wind is an idle, wanton worker, who demands many playdays and much sleep. He is a servant whose efforts constantly vary from nothing to too much. Much of the time he will not work at all; then, to make up for lost time, he works "like a house a'fire" (*à outrance*), or breaks his machine into fragments and hurls them at his master.

Still, wind-mills are coming more and more into use. We do not disparage them. We do not esteem wind-mills less, but current-motors more. If the feeble and variable force of the wind can be so profitably employed,[*] how much more can a powerful stream which *flows regularly night and day and in an unvarying direction*.

'Tis true that the *locality of use* is more restricted with current-motors (and this has operated against their being more generally known), but there are thousands of miles of river shore where they will furnish power at one-half to one-tenth the cost of steam. After one or two current-motors are placed in such rivers as the St. Clair, power-users in the United States will awaken to their value. In the St. Clair there is, for several miles, a current of six to seven miles per hour. This is a force equal to the hurricane that uproots large trees.

Much swifter currents are found at many rapids. In high water many parts of the Mississippi and hundreds of miles of the Missouri have a current of 7 miles an hour.

This represents a pressure of 940 *lbs. to the square yard*. A current motor with 40 sq. yds of paddles or suitably braced sails, exposed to the action of such a current, would yield 180 horse power, and, working 24 hrs., would equal 432 *horse power 10 hrs. a day*.

$$\frac{K.\ P.\ A.\ V^2}{2g \times 75} = \text{the horse power.}$$

$K = 3.$

P, the weight of a cubic metre of water (1,000 kilograms).

A, the area, in square metres, of surface exposed to the action of the current.

V, velocity in metres per second.

g, gravity (9.8).

75, the number of kilogrammetres in a horse power.

Current-motors require no dam, canal nor tail-race.

On swift streams power can be obtained from current-motors at much less cost than by building dams: but grant all that dam-builders claim, and we still find that most of the water power of this country must be utilized by current-motors, *if used at all*, for two reasons:

1st. On most important streams dams are not permitted.

2d. On the rivers where permitted there are few places where sufficient power is desired in one locality to justify the cost of a dam. In other words, *there are few localities that are worth a dam*. Experience has proven the uncertainty of renting the surplus power, and *not $\frac{1}{10}$ part of the power of the rivers of this country is utilized by dams*. There are millions of horse-power in the Mississippi alone. *There is only one way to get it out* (after it has passed the falls of St. Anthony), *and that is by current-motors.*

Columbus, Kentucky, for instance, might need 1,000 horse-power, but they could not afford to pay $5,000,000 for a dam across the Mississippi, even were it possible for them to raise such a sum, and were a dam permitted.

Dam builders say, "You must have a fall." True, and the bed of a stream is a continuous fall—"w(h)at-er fall is there, my countrymen!"

It is unfortunate that the few current-motors that have been used in this country have been placed in slow streams. Seeing only five horse-power from a wheel in a current of two miles per hour, power users naturally supposed they would only get 10, or at most 20, in a four-mile current, whereas they would, in a current of four miles an hour, have a yield of 40 horse-power from the same size machine (the power of a running stream, for any given area of transverse section, increasing as the cubes of the velocities). Thus it is that a motor, which might be a nuisance in a slow current, may effect surprising economy in a swift one. An increase of velocity of the current can, in small rivers, generally be cheaply obtained by wings of rip-rap or piles.

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[*] In Holland and Belgium wind-mills have performed herculean tasks—driving back the ocean and making his former bed to "blossom like the rose." There are thousands of places where wind-mills are not used, where great economy could be effected by their employment.

With the wind-mill in successful and extensive use, to ignore the possibilities of the current-motor is to deny the difference of pressure between wind and water.

Their disadvantages are more imaginary than real but like the steam engine and all other motors they have disadvantages. In some rivers they must be protected from drift, and in the North from floating ice. This protection, when ice is not too heavy, is secured by strings of floating spars (booms), placed around them. During heavy running ice they must be beached, harbored or scuttled, but they work in a frozen river. They don't blow up nor burn down. If sunken they may rise again.

Even with three months annual loss of time their employment as auxiliary to steam (using the current-motor nine months of the year) effects great saving. In fact the saving over steam in one year's use would, in some localities, pay the cost of the current-motor.

Current-motors do not interfere with navigation. They are not placed directly in the channel. A river deep enough for navigation is wide enough for both steamboats and current-motors.

An intelligent use of the power of currents for manufacturing, farming, etc., would produce results, which, if stated now, would seem to fanciful for belief. It is the cheapest power there is, and the most abundant. It would occupy the whole human race 500 years to raise the quantity of water daily drawn from the sea by the sun and precipitated upon the earth.

Thompson, in "The Land and the Book" referring to the common rude current-wheel says: "This system of water-wheels is seen on a grand scale all along the Orontes. There is probably no hydraulic machinery in the world by which so much water is raised to so great an elevation at so small expense." A large part of the manufacturing of Verona—one of the principal manufacturing cities of Italy—is now done by current-motors, the river, at places, being literally filled with them.

Current-motors are placed one after another, as the current soon regains its velocity, while *water at a fall can be used but once*. On the river Adige 160 mills and factories are operated by current-motors.

The coming man will put the current to hundreds of different uses, and the time will come (on swift streams at least) when the current running down will propel the vessel up, and at a higher rate of speed than is profitable by steam. Current-motors will supply compressed air or storage batteries, for propulsion. All the inventions necessary to the success of such navigation are already made, and only await the "live man" to rise up and apply them. He may come to-morrow; he may not come for 50 years; but he will come Fire and explosion are most disastrous on water. Removing these dangers, and heat and smoke, increases travel and reduces insurance. It will at first seem queer to see boats skimming along without smoke-stack or steam—as queer as to see a boat without a profane mate.

Current-motors could furnish electric light to a town at night and pump their water by day. They are very valuable to farmers near streams. The same motor that does any kind of work during the day will irrigate at night. A small motor irrigates a large tract of land. Few appreciate the importance and profit of irrigation. No droughts feared. Crops often quadrupled. *All soils are productive when properly irrigated.*

The farms or factory using water power need not be upon the banks of a stream. Power may be and already is in many places transmitted "over the hills and far away." Three miles for wire ropes is the maximum profitable distance fixed by high authority, Roebling Bros. Hirm Brothers claim 10 or 12 miles will, in some cases, pay. Fifty horse power may, at a velocity of a mile a minute, be transmitted with a wire rope the diameter of a lady's finger, while it is claimed by high electric authority (Sir Wm. Thompson and others) that water power may, with electric wires, be profitably conveyed "50 miles from its source."

Steam grows dearer as fuel, engineer and stoker advance in cost. The rivers carry to the sea 900,000 cubic miles of water annually; raised by the sun it hurries back to re-descend in rain; man has watched it for a hundred centuries resistlessly rolling past his door; Nature has waited a hundred centuries for man to utilize its ceaseless flow.

> "Om mani padme hom, the sunrise comes
> The dewdrop slips into the shining sea"—

in the rivers rolling to the sea are millions of horse-power daily running to waste. We do not appreciate the brook and river because they are so near and have been there so long. Had they commenced flowing but to-day we would hasten to harness them.

The running stream is an endless driving-band reeled out by Nature from the hollow of her hand; current-motors placed in gear with it revolve till worn away; they enslave the giant of the rolling river, chain him to their tasks, and make of him a patient drudge as long as waters flow; he works days without murmur, nights without sleep and Sundays without sin, with Nature for his only driver.

THE KINZUA VIADUCT.

In a note copied from the New York *Sun* last week into this journal, it was stated that $8 was being offered for men to work on that structure. From the contractors, Messrs. Clarke, Reeves & Co., we learn that the statement is not correct. They say: "We pay foremen on that work five dollars to six dollars per day; other workmen from two dollars to three dollars per day. These men are nearly all our old bridge erectors; they are satisfied with their pay and not afraid to go up 300 feet; in fact they wish the structure was twice as high. One hundred men are now working as erectors. The structure is more than one-half erected, and will be completed by September 1, 1882. Thus far only one man has been hurt, but he is now at work again. The viaduct is being erected *without the use of a single ladder, plank or any staging whatever*. The men go up and down on the longitudinal and transverse rods, and do all the work of connecting, screwing up and adjusting, by standing or sitting upon the transverse and longitudinal struts, which are 12 inches wide. The viaduct trestle is constructed in such a manner as to require no riveting, chipping, filing or fitting of any kind. Thus far not a chisel has been used in erecting."

WANTED.—A SUPERINTENDENT OF WATER-WORKS.

The following advertisement appears in a Pittsburgh official paper:

OFFICE OF CITY CONTROLLER,
PITTSBURGH, July 15, 1882.

TO MECHANICAL ENGINEERS — UNDER the provisions of an ordinance relating to the office of Superintendent of Water-Works, and fixing the salary of same, the Water Committee invite applications from mechanical engineers. All applications must be filed with the Controller until August 4, 1882. All applications must be accompanied by certificates and proofs as to the applicant's competency as a skilled mechanical engineer. The salary of the Superintendent is four thousand dollars per annum.

E. S. MORROW, Controller.

The Pittsburgh water-works have been a byeword for many years, for bad management. It has been a wonder to every one outside of that city that in a place which abounds in business men of extraordinary capacity for management of affairs, full of firms which control great enterprises, reaching out to all parts of the country, a great municipal work should be managed with such utter disregard of business principles. And now they go from bad to worse. It is difficult to conceive of a worse method of procuring a good and efficient superintendent of water-works than the one adopted by the city council according to the above advertisement. We doubt if a single really competent man for the position will put himself up for competition under the terms of this call. Think of such men as Davis, Hermany, or Whitman answering such an advertisement. But that is the kind of men they want in Pittsburgh. Not a mere engine driver or machinist but a trained and experienced civil engineer who knows what is wanted and can carry it out even if he is not able to bring testimonials of his ability to plane a joint or chip a casting.

NEW PUBLICATIONS.

The Proceedings of the Engineers' Club of Philadelphia for June is received. It is perhaps the most valuable of all the many valuable contributions to engineering literature that have been given to the profession by this enterprising society. The contents are: A Personal Sketch of Lewis M. Haupt, Past President of the Club, illustrated; Application of Logarithms to Problems in Gearing, by Wilfred Lewis; The Working Strength of Bridge Posts, by Geo. P. Bland; What Thickness of Metal Should be Given to Cast Iron Water Pipes Under Pressure, by P. H. Baermann, illustrated by four folding plates; Resistance to Traction on Roads, by Rudolph Hering; Philadelphia & Long Branch Railway, by C. S. d'Invilliers; Brick Work Under Water Pressure, by D. McN. Stauffer; On the Strength of Wrought Iron Columns, by T. S. Cleeman; Expansion of Iron Embedded in Brick Work, illustrated; Mechanical Boiler Cleaner; Auchincloss' Averaging Machine. The Proceedings are edited by the Secretary, Howard Murphy, and copies are for sale (although we do not speak by authority on this point) at 1523 Chestnut street, Philadelphia.

The contents of the *Journal of the Franklin Institute* for August are: On a Theorem of Rankine Relating to the Economy of Single Acting Expansion Engines, first published in 1851, by Prof. W. P. Trowbrige; The Specific Heat of Platinum, and the Use of this Metal in the Pyrometer, by J. C. Hoadley; Bell Chimes in Philadelphia and other Places, by John W. Nystrom; Electric Clocks and Time Telegraphs, by Louis H. Speilier; Feldspar as a Source of Potash Alum, by John Spiller; On the Prevention of Fires in Theatres, by C. John Hexamer; The Pollution of the Schuylkill River, Report; Recent Improvements in the Mechanic Arts.

The North American Review for August is an especially excellent number of that excellent magazine. Rev. H. W. Beecher discourses on the Progress of Thought in the Church. He says, among other things:

> "The development of physical science constitutes the grand feature of the last half century. The doctrine of the *Conservation of Forces* and the discovery of the method of creation, viz.: *Evolution*, while revolutionizing physical science, will powerfully reform social and moral theories. At length the flood of ignorance has abated, and the dove of truth has solid ground on which to put its foot. The study of the human mind from the side of physics as well as metaphysics is productive of changes of the most radical and important kind. Religion has much to hope, and the old theology much to fear from scientific disclosures."

T. V. Powderly has an article on The Organization of Labor, in which the relations of labor and capital, strikes, etc., are discussed. Archibald Forbes, the great war correspondent, writes some interesting things about the United States Army; Woman's Work and Wages, by Chas. W. Elliott; The Ethics of Gambling, by O. B. Frothingham; The Remuneration of Public Servants, by Frank D. Y. Carpenter, are all very readable and very useful information; Dr. C. A. White has an article on Artesian Wells upon the Great Plains, in which he shows from tha geological structure of the country the uncertainty of such a source of water supply and the unavailability of it on account of the great cost of sinking such wells. The *Review* is not light magazine reading, but it is a very useful publication. The office is 30 Lafayette Place, N. Y. city, and the price is five dollars per year.

PERSONAL.

C. M. Kendall is superintendent and chief engineer of the Denver Circle railroad; offices in Denver, Col.

President Arthur has sent the following nominations to the Senate: Captains **William Ludlow** and **William A. Jones**, Corps of Engineers, to be Majors.

R. French, for several years roadmaster of the Mahoning division of the New York, Pennsylvania & Ohio has been appointed chief engineer of the Cleveland, Mt. Vernon & Columbus road.

F. C. Hand has been appointed Chief Engineer of the California Short Line Railroad Company, lately organized; offices, Salt Lake City. The purpose is to build from Salina, on the Sevier river, to Springville, where connection will be made with the Denver & Rio Grande. The locations have been made, and it is expected notice of letting work will be given within the next thirty days.

Mr. Robert Briggs, a well-known civil and mechanical engineer, of Philadelphia, died at his mother's residence, in Dedham, Mass., July 24, after a lingering and painful illness. Mr. **Briggs** was born in Boston, May 18, 1822, and was educated in the Boston schools, pursuing his professional studies under Capt. **Alexander Parris**, an engineer and architect, of Boston. He spent much of his life in Washington and Philadelphia. He was employed as engineer under Gen. **Meigs** in the extension of the National Capitol and in the construction of the Washington Acqueduct. He was afterward superintendent of the Morris & Tasker Iron Works, at Philadelphia, and subsequently associated with **Henry G. Morris**, in the Southwark Foundry. The large pumping-engine of the Lowell water-works was built under his direction. Of late years he has been employed as a consulting engineer, and, up to the time of his last illness, he held that position in the United States Engineer's office, in Philadelphia. Mr. **Briggs** was for a time the editor of the *Journal of the Franklin Institute*, and was a member of several associations of architects and engineers in this country. He had also the honor of being elected, some years ago, a member of both the institutions of civil engineers and of mechanical engineers in London.

Thomas Guardia, who has presided over the destinies of the Republic of Costa Rica for nearly twelve years, died on the 7th inst. Personally President **Guardia** was an ignorant, unlettered man, whose idea, so far as society was concerned, was to present the greatest display possible. He was no politician, and through his whole career in the republic gave no evidence of his skill in that regard, except by a few decrees, which will die with him. He had the crudest ideas of finance, and plunged his country into an abyss of debt, from which it will not recover for many years. He wished to associate his name with some great national work, and the idea of an interoceanic railroad captivated his imagination. He commenced it, but began the work of grading and track-laying in the center of the country instead of on the shore. As may be supposed, every rail cost a small fortune, and two locomotives, which were imported to begin tha work, cost for land transportation alone $30,000 each. Such extravagance naturally brought with it a result which everybody expected. The millions which the bondholders furnished were dissipated; spent without reason or purpose, until nothing remained. But still **Guardia** clung to the idea of a railroad, and for five years spent every cent of revenue he could divert to the purpose to the prolongation of the railroad. To-day Costa Rica is ruined in credit, and every resource is pledged in one way or another to the ideas of the late President. The millions **Guardia** spent have simply given the country a few miles of railroad, divided into three sections, and which will never be of positive benefit until they are connected.

Mr. Arthur Gilman, a well-known architect, died in Syracuse, N. Y., on the 11th inst. He was born in Newburyport, Mass., and was a graduate of Trinity College, Hartford. Becoming deeply interested in architecture, he published in the *North American Review* for April, 1844, a paper on "American Architecture," which at once attracted wide-spread attention. It was copied in Europe, and translated into several foreign languages, and on the strength of it Mr. **Gilman** was appointed to deliver a course of twelve lectures on that subject before the Lowell Institute at Boston. After delivering these lectures Mr. **Gilman** went to Europe on a tour of professional observation, and passed some time in study and travel abroad, receiving much civility and attention from Sir **Charles Cockerell** at that time the President of the British Institute of Architects, from Prof. **Donaldson**, the Foreign Secretary of that same body, and especially from Sir **Charles Barry**, the distinguished architect of the Houses of Parliament. To the friendship of Sir **Charles Barry** Mr. **Gilman** was indebted for many opportunities of seeing all that was best and most valuable in the architecture of England. He visited and studied all the finest English cathedrals. This experience confirmed his faith in the principles and his love for the forms of the Anglo-Norman and German schools in architecture. Nor did he neglect the literary opportunities of his tour. **Thackeray**, with whom Mr. **Gilman** had become acquainted in America, entertained him most hospitably, and introduced him to the Garrick and Fielding clubs, where, as a "king of Raconteurs," to use **Thackeray**'s words, he was welcomed and admired by men like **Charles Reade**, **Tom Taylor**, **Mark Lemon**, **Albert Smith**—then in the height of his "Mont Blanc" success—**John Leech**, the gifted artist of *Punch*, and the incomparable **Thackeray** himself. Mr. **Gilmam**, before his return to Boston, matured a plan designed by himself for filling in and improving tha "Back Bay" territory, then lying waste. Ha urged the plan upon the city government and the public with speech and pen for years, before the Legislature and elsewhere, and at last had the satisfaction of seeing his views carried out by the State of Massachusetts. From these improvements the Commonwealth has realized millions of dollars, "with more to come," and a new and elegant quarter has been added to the city. "Commonwealth avenue," which owes its width and extent almost entirely to Mr. **Gilman**'s persistent efforts, has already become one of the finest streets in the world. He built the Boston City Hall, which is perhaps his best work, and he designed for the late Mr. **Cranston** a superb hotel, which if constructed would have been the finest in America. In 1865 Mr. **Gilman** removed to New York, where, by his distinguished ability, his facile pen, his ready command of language, and his fine and scholarly tastes, he soon won hosts of appreciative friends. He was a member of the Union and New York clubs, and for many years of the American Institute of Architecture. He leaves a widow and one son twalve years of age.

RECENT INVENTIONS.

STATIONARY WASHSTAND AND FIXTURES.

This improved stationary washstand comprises a supporting slab and a basin provided with outlet and overflow openings. It is also provided with an inlet opening in the wall of tha basin, and a valve constructed to allow the flow of hot or of cold, or of hot and cold water mixed, the valve being supported by the slab and below the same, and provided with a stem or key projecting through the slab, but flush with the upper surface thereof, so arranged as to leave the top of the stand free from obstructions of any kind.

PROCESS OF UTILIZING THE PRODUCTS OF COMBUSTION.

This improved method consists in utilizing all the heat arising from the combustion of fuel, and eliminating the injurious products. The heat generating devices are connected with a sewer or other main, and the injurious products forced through such sewer or main away from the inhabitants by positive mechanical means, and through a series of heat-utilizing devices, such mechanical means being employed in connection with a chimney or with the sewer or main.

IMPROVED SEWER AND MEANS FOR DISCHARGING SEWAGE.

In this invention the sewer system of a city is divided into working sections, each section being provided as to its main and branches with graduated air inlets, and near its discharge point with an exhaust mechanism, for tha purpose of drawing in fresh air at the inlets and expelling the sewer air at the discharge, and with a velocity to materially expedite the discharge of the sewage, drive through an obstruction, and effectually ventilate the system.

NOVEL GAS MACHINE.

In this improved gas machina the carbureting pans or chambers are provided with double overflow tubes, having openings near the bottom of the outer shell or tube, and also openings near the top of the inner shell or tube, whereby the heavier oil is passed from the bottom of one pan to the pan below to tha bottom chamber. Air to be carbureted enters first the bottom chamber containing the heaviest oil, and ascends through the overflow tubes, coming in contact with the lighter oil at the top chamber, in order that both heavy and light oil may be vaporized and carried off more uniformly by the air.

Washington, D. C. F. B. Brock.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES M. AM. SOC. C. E.

(Continued from page 251.)

CCCLXI.—SOUTH NORWALK.

South Norwalk, Connecticut, in lat. 41° 7' N., long. 73° 24' W., is on rolling ground on the shore of Long Island Sound, at the mouth of the Norwalk River. It was settled in 1649.

Water-works were built by the town in 1875, after plans of William B. Rider, taking the supply from a stream 5 miles from the city, impounded in two reservoirs, which contain 166,000,000 gallons, and are formed by earthen dams, with rubbla masonry heart walls laid in cement. Tha watershed is about 5 square miles. Tha reservoir is 223 ft. above the city. At the outlet the water is filtered through charcoal and sponge, and is then conveyed to the city through 4¾ miles of 12-in. cast-iron pipe.

Distribution is by 9 miles of cast-iron pipes of from 2 to 4 in, diameter, with 58 fire hydrants and 65 gates. The number of taps is not furnished. One meter is in use. Tha city formerly paid $25 per annum for each hydrant, but now the receipts from water rates exceed the expenses. Lead, iron and brass are used for service pipes. The population in 1880 was 5,300. The daily consumption is not given.

The works cost $100,000. Further financial statistics are not furnished, except that the revenue is now 2½ per cent. in excess of cost of maintenance and interest on debt.

The works are managed by three water commissioners, elected for three years. W. B. Rider is the engineer.

CCCLXII.—GOSHEN, Y. N.

Goshen, New York, in lat. 41° 2' N., long. 74° 8' W. is in a hilly region, about 20 milea west of the Hudson river.

Settled in 1714. It was incorporated as a village in 1809, and re-incorporated in 1843 and 1878.

Water-works were built in 1871 by the city, under superintendence of C. Colwell, taking the supply from springs and a small stream about a mile from the town which is impounded by an earth dam 37 ft. high and 266 ft. long 12 ft. wide on top. The area of the reservoir is twenty-three acres, and its water shed 250 acres. It contains 46,000,000 gallons, 120 ft. above the city, to which the water is conveyed in a 12 in. wrought-iron and cement pipe, and distributed by six and a half miles of the same pipe, of 10 to 4 in, diameter;

with 46 fire hydrants, 17 gates and 281 taps. Lead service pipes are used.

The population in 1880 was 2,546. The consumption is not given.

The works cost $60,000. The bonded debt is $85,000 at five to seven per cent. interest.

The expenses in 1881, were $2,600 including interest, and the receipts were $2,600.

T. D. Tuthill is the Water Commissioner and Superintendent.

CCCLXIII.—WACO, TEXAS.

Waco, Texes, in lat. 31° 22' N., long. 97° 4' W., is on the Brazos River, on ground rising from the west bank to the river, to an elevation of 130 ft. in 1¼ mile.

Settled in 1830, it was incorporated as a city in 1858.

Water-works were built in 1878 by C. W. White, for a private company. The supply is taken from a well 16 ft. in diameter and 42 ft. deep, the lower 12 ft. being through coarse water-bearing gravel. The water is pumped 105 ft. by a Knowles steam pump into wooden tanks holding 100,000 gallons. The pressure is obtained by pumping directly into the mains.

Distribution is by 9 miles of cast iron pipe of from 12 to 3 in. diameter, with 35 fire hydrants, 12 gates and 534 taps. There are 70 meters in use. The city pays $2,800 per year for fire hydrants. Service pipes are of wrought iron.

The population in 1880 was 7,317. The daily consumption varies from 150,000 gallons in winter to 350,000 gallons in summer.

The capital stock of the company is $100,000. The works have cost $80,000. The bonded debt is $10,000 at 10 per cent. and $40,000 at 7 per cent. interest. The expenses in 1881 were $4,000 and the receipts $12,000.

C. W. White is President and James E. Eagen the superintendent and secretary.

CCCLXIV.—PARK CITY.

Park City, Utah, in lat. 40° 45' N., long. 112° W., on Silver Creek, lies at the mouth of a gulch or cañon in the foot hills of the Wahsatch range of mountains. The site rises steeply from the stream each way.

Settled as a mining camp in 1870 it was laid out in plats in 1876, but has not been incorporated.

Water-works were built by a private company in 1880 after plans of W. M. Ferry, taking the supply from a mountain stream a mile from the town. Three dams of stone form three successive reservoirs, of an average depth of 12 ft. and aggregate capacity of 1,000,000 gallons. The water, when the upper reservoir is full, falls over the dam 12 ft. to the next one, and in like manner over the second dam. From the lower reservoir it is drawn to the city. The dam is of dry stone masonry, founded on brush and filled in on each side with coarse gravel.

The two upper reservoirs can be cleared out through a tight box flume passing under the two lower dams without disturbing the water in the lower reservoir. In 1881 a "cloud burst" from the mountains filled the two upper reservoirs with débris, which was flushed out in one day through this flume. The reservoir is 200 ft. above the town.

Distribution is by Horton's wood pipe, made of Oregon pine, spirally banded with iron. It is of 8-in., 6-in., 3-in. and 2-in. diameters. Some of the pipe first laid was badly manufactured and had to be replaced. The length of pipe laid is not given, nor the number of taps. There are six fire hydrants and 12 gates. The town does not pay for use of hydrants. Galvanized iron service-pipes are used. The population in 1880 was 1,500, and is now about 3,000. The daily consumption is not given. The capital stock of the company is $20,000. The works cost $19,000. There is no debt. No further financial statements are given, but they are promised at the end of the year.

William M. Ferry is the Superintendent, and Thomas Cupit, Secretary.

CCCLXV.—DUTCH FLAT.

Dutch Flat, California, in lat. 39° N., long. 121° W., is on a ridge between the Bear and American rivers, 3 400 ft. above the sea.

It was settled in 1846.

Water-works were built in 1859 by private enterprise.

The supply is taken from springs and miners' ditches, and collected in a reservoir in embankment, lined with wood, 40x60 ft. square and 8 ft. deep, at 200 ft. above the town. The pipes are from 18 to 6 in. diameter of sheet-iron, coated with asphalt, and of cast-iron, and there are also used in the distribution logs of 2-in. bore, lead-pipe and plain and galvanized wrought-iron pipe of 2 in. to ¾-in. diameter. There are laid 1½ miles, with 10 fire hydrants and 200 taps.

The town contributed $2,500 towards the construction of the works, and the proprietor guaranteed the supply and free water for fires. Wrought-iron service pipes are used.

The population in 1880 was 1,185. The consumption cannot be correctly estimated.

The works have cost $5,000, and the receipts have been $3,600. There is no debt.

The expenses in 1881 were $700, and the receipts $1,400.

The works have been owned and managed since 1865 by Isaac Tibbitts Coffin.

CCCLXVI.—NEW CARLISLE, IND.

New Carlisle, Indiana, is in lat. 41° 44' N., long. 86° 32' W. The town was settled in 1840. Water-works were built by the village in 1878 after plans of George C. Morgan, taking the supply from a well 10 ft. in diameter and 35 ft. deep. The water level is 23 ft. below the surface of the ground. There are four 2½-in. pipes driven in the bottom of the well. The water is pumped by a Worthington duplex engine, with 7-in. pump bore, to a height of 92 ft. into a tank 18 by 22 ft. and 25 ft. high. In case of fire water is pumped directly into the mains under 100 lbs. pressure.

Distribution is by ⅞ mile of 6-in. and 4-in. Wyckoff wooden pipe, with 13 fire hydrants and 2 gates. The number of taps is not given. Service pipes are of galvanized iron.

The population in 1880 was 5,500. The daily consumption is not given.

The works cost $7,000. There is a bonded debt of $5,000 at 7 per cent. interest.

Further financial statements are not furnished. The works are managed by a board of three commissioners. F. D. Warren is the Treasurer and W. H. Wade the Superintendent.

CCCLXVII.—WINNEMUCCA.

Winnemucca, Nevada, in lat. 40° 58', 20" N. long., 117° 43' 54" W. is in the mining district, along the line of the Central Pacific Railroad.

The town was settled about 1870.

Water-works were built by a private company in 1877 after the plans of J. Culver, taking the suppy from Cross Cañon in the Harmony Mountains, and conveying the water by a 7 in. wrought iron pipe to a small reservoir 125 ft. above the town. A storage reservoir is now building in the cañon, 100 ft. square and 16 ft. deep at 950 ft. above the town.

Distribution is by 5 miles of 5-in. wrought iron pipe, with 10 fire hydrants and 100 taps.

The population is now 800, and the average daily consumption 250,000 gallons. In August and September the consumption is about equal to the supply.

The works cost originally $16,000, and $12,000 has since been expended in reconstruction. J. B. Gramm is the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is acknowledged with thanks: From William M. Terry, Superintendent, statistics and water rates of the water-works of Park City, Utah. From T. D. Tuthill, Treasurer and Superintendent, statistics and water rates of the water-works of Goshen, N. Y. From W. B. Rider, Engineer, statistics of the water-works of South Norwalk, Conn. From Isaac Tibbitts Coffin, statistics of the water-works of Dutch Flat, Cal. From George A. King, C. E., annual report of the water-works of Taunton for 1880. From C. W. White, President, statistics and water rates of the water-works of Waco, Texas. From F. D. Warner, Treasurer, statistics of the water-works of New Carlisle, Ind. From Eugene Ricksecker, U. S. Geol. Survey, statistics of the water-works of Winnemucca, Nevada. From R. J. Braugh, City Engineer, reports for 1881.

CORRECTION.—July 22, 1882, p. 251.—*Palestine.*—End of second paragraph, for "*steam pipes*" read "steam pumps."

Brookline.—Near end of third paragraph, for "great discoloration" read "peaty discoloration." End of fourth paragraph, for "sands" read "sand." Beginning of fifth paragraph, for "Washington" read "Worthington."

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THE SUEZ CANAL AND PORT SAID.

THE IMPORTANCE OF THE GREAT HIGHWAY BETWEEN EUROPE AND THE EAST.

The telegram from Suez apprising us that up to yesterday morning no vessel had been permitted to enter the canal for 48 hours past brings more vividly before our minds the importance of that great highway between Europe and the East than anything that has happened since the grand ceremony of the opening in 1869. To our commerce this barrier to the progress of vessels, both homeward and outward bound, is, we need hardly say, of far more importance than to that of any other nation. So that, at least, it cannot be said that Admiral Seymour's precautionary order has inflicted on our neighbors any inconveniences which have not been shared, and in far greater degree, by the English seafaring and mercantile world. The figures speak for themselves. The great work of M. de Lesseps, as we all know, was not due in its inception to English enterprise, nor did it, we must with sorrow confess, receive much encouragement from English statesmen of any party, but it was yet predestined to be essentially the great route for our vessels, and from the first British commerce through the canal has necessarily overshadowed that of every other nation. Last year no fewer than 2,728 vessels passed through, of which all but 471 were British, representing nearly 3,500,000 net tons, only 72,000 tons of which were Government shipping. Thus 82 in 100 of all these vessels carried the British flag, representing 83 per cent. of the entire traffic. The rapidity with which the habit of using the canal by vessels trading between Europe and the East has increased is still more striking. In 1870, the year after the opening, there were only 480 ships, with a gross tonnage of 436,000 tons. Five years later the number had risen more than four-fold, and their tonnage nearly six-fold. The temporary damming up of this stream of commerce concentrates attention for the moment on the entrances, which, in a certain sense, were the crowning triumphs of the labors of the French engineers. Some account of Port Said and Suez, therefore, by way of refreshing the memory of readers, may here be of interest. Port Said, we may premise, is distant by sea from Alexandria about 140 miles. The port is purely the recent creation of human ingenuity and labor; and the town which has sprung up behind it, though numbering now at least 10,000 inhabitants, is not less the creation of the port. As M. le Masson, the French engineer, observed, it is a port "*contre nature.*" We may add, it is one that but for man's attention and care must in the course of no great length of time cease again to exist. Perhaps these facts may go some way toward palliating the mistake of the prophets who were wont to confront the projectors with the difficulty of the "entrances." Given the canal itself, what, after all, is a canal without a way of getting into and out of it? This was the question which pressed most heavily on the minds of those who were responsible for the enterprise in the days when the great problem of ways and means was suggesting ingenious schemes and complicated transactions, while a writer in the *Edinburgh Review* had emphatically assured the public that "any construction attempted so as to form an entrance for the canal will be swallowed up," and that "not a single stone would be left above water." At this Mediterranean extremity, indeed, the prospect might well have daunted the heart of the most courageous of projectors. The problem was to get depth upon a comparatively shallow sandy coast, and this was practically attained by commencing the work on a sand-bank 26 miles from the main land. This long bank or belt of sand, extending from the mouth of the Damietta branch of the Nile to the Gulf of Pelusium, is described in Mr. Wyld's map as being of fine gray sand, five feet only above low water mark, and varying from 109 to 164 yards in width. Behind this irregular barrier is the shallow lake of Menzaleh, through which it was, of course, necessary to make an artificial channel for the canal. The first thing to be accomplished, however, was to construct the foundations for the future town to be named after the then Viceroy, and then to project into the sea the two enormous breakwaters or moles which form the outer port and protect it against that constant tendency to the accumulation of sand which, even as it is, demands constant dredging. The spot chosen on the sand-bank, or strip of what is locally known as "slob," is described as little more than 500 feet wide. The plan of the engineers was simple. At first a light framing of piles was run out on which a crane and trucks laden with loose stones traveled and in a short time a fairly substantial pier that served as a landing stage for materials and machinery was constructed. Here was, in fact, the great workshop of the undertaking throughout the ten years of its construction. Encouraged by this success (says Mr. Fitzgerald) a bolder work was ventured o . Out in the bay, at nearly a mile distant, huge piles were screwed into the sands, and an oblong island was then formed with stones, the space between this island and the wooden shore pier being gradually filled in. Every day the piles settled firmly in their places, in spite of the storms of the bay. This temporary structure was carried out to a distance of about 300 feet, and it was not till three years before the canal was complete and ready for opening that the work was seriously resumed, and the breakwater joined to the pier. Two officers employed by the British government to examine the port describe it as formed by two rough, narrow, and low breakwaters, inclosing an area of some 450 acres, with an average depth of only 13 or 14 feet of water, except in the ship channel (about 300 feet wide) leading to the inner basins, where the depth is from 25 to 28 feet. The western breakwater, which extends for 6,940 feet at right angles to the shore, and is slightly curved eastward towards its extremity, was commenced in 1860, and carried out about 1,350 feet, beyond which point, and at a distance from it, was deposited a heap of stones that was surrounded by iron piles, and from its detached position was called "the island." The work was then left untouched till 1866, when the breakwater was joined to the island, and it was continued to its present length and finished in 1868. From the mainland to the island the breakwater is formed on its inner side of a bank of rubble stones, surmounted by a promenade, over which the spray breaks with a very moderate north-west wind, and on the outer or sea front of concrete blocks, but beyond the island to its termination it is entirely constructed of large blocks of artificial stone, composed of one part of French hydraulic lime with two parts of sand, and some of which were transferred to it from the eastern breakwater. This latter, which is also constructed of large masses of concrete, is of more recent construction, extending to about 6,020 feet, and converging toward the western harbor. Such is the harbor of Port Said. It cannot, according to these authorities, be considered as a harbor either in respect of extent or depth for vessels of large tonnage and great draught; but, slightly improved and well maintained, it has, as we have seen, nobly served its purpose. Near the commencement of the West Mole is the light-house, the tower of which, composed of a solid mass of concrete, is 160 feet high, lighted by an electric light flashing every 20 seconds, and visible at a distance of 20 miles. Three other light-houses of the same height, though differing in construction, have been erected along the coast between the fort and Alexandria. It is interesting to know that the solid block of concrete or artificial stone so extensively used have, at least below water, become firmer and more trustworthy by reason of the growth of sea-weed upon them. Port Said is described in the latest edition of Mr. Murray's invaluable "Hand-book of Lower and Upper Egypt" as now regularly laid out in streets and squares, with docks, quays, churches, hospitals, mosques, and hotels, and all the adjuncts of a seaport, and with the most easily approached and safest harbor along the coast. Fresh water is supplied to it from Ismallia, that now famous half-way house of the canal voyage. The town, we are told, no longer presents the same busy appearance which it did when it was the head-quarters of the engineering work; but the increasing traffic through the isthmus always imparts a certain activity to the place.

The port of Suez, where more than one impatient captain, and we fear not a few equally impatient passengers, were probably yesterday anathematizing the bombardment and the obstinacy of Arabi Pasha, cannot boast of the almost romantic interest of the story of the great engineering enterprise which bade a town and port arise out of the sea. Yet here the whole of the ground on which the quays and other constructions stand has in like manner been recovered from the sea, and it is proposed, at some future time, to rescue the whole of the swamp lying between the town and the new ports (a distance of about two miles), which is now joined by a massive embankment of artificial stone, along which the road and railway pass. The entrance to the canal channel, protected by an extensive breakwater, is marked on the map as 27 feet in depth. The entrance to Port Ibrahim on the left of the voyager arriving from the Red Sea is divided by a long jetty into two parts, one for ships of war and the other for merchant ships. On the jetty, close to the quays to which the large steamers moor, is the station of the railway, Suez, unlike Port Said, being in communication with the whole net-work of Egyptian lines, affording easy access to Ismailia, Cairo, Mansurah, Damietta, Rosetta and Alexandria. The roadstead at Suez is capable of accommodating 500 vessels of all sizes. The actual town is of comprratively modern date, and, like Port Said, is dependent for its prosperity on the traffic through the canal. What remains of the ancient town is of little interest, and visitors to this part are mostly attracted by the magnificent view of the harbor, the roadstead, the mouth of the canal, the "range of Gebel Attakah, with its black-violet heights hemming in the Red Sea, the rosy peaks of Mount Sinai, and between the two the deep blue of the gulf."—*London News.*

EGYPTIAN WATER SUPPLY.

The Mahmudieh fresh-water canal, constructed by Mehemet Ali at a cost of 20,000 or 30,000 Egyptian lives, is once more playing its part in a national tragedy, having been dammed by Arabi Pasha with the two-fold object of depriving Alexandria of water, and flooding the surrounding country so as to make it impassible for troops and artillery. This Dutch method of warfare is of considerable antiquity in the East. Cyrus employed it against Babylon, the Persian General Megabyzus against the Greek garrison of an Egyptian fortress. In later days, Octai Khan, the great Mongol conqueror took Khiva by a dam which diverted the protecting stream of the Oxus into the channel which it still holds. The Duke of Parma used this device against Antwerp, Richelieu against La Rochelle. In the wars of Holland against Spain in the sixteenth, and France in the seventeenth century, its use was continual and effective. During the Russian campaign of 1873 in Central Asia, the Khivans, earning wisdom from their misfortunes, dammed the estuary of the Oxus to make it too shallow for the Russian gun-boats, while deepening the upper stream as an obstacle to their land force. The escape of several Union gun-boats by the timely construction of a dam from being stranded in a Southern river is still fresh in public memory.

THE GOTHARD TUNNEL.

THE motive power for the Gothard tunnel has been the subject of much investigation. The air in the tunnel is extemely hot, good ventilation by any means yet discovered is impracticable, and to have the locomotives for a heavy traffic discharge the products of combustion and the exhaust steam in it would, it is thought, make the passage extremely unpleasant for travellers and train men. It was proposed to have it worked by a travelling rope and a stationary engine, but this was dismissed without much consideration as likely to be inadequate for the heavy traffic expected. The management of the road seriously investigated the application of electric motors of the Siemens' system, and obtained plans and estimates from the Berlin firm. It purposed to put two copper cables 1 in. in diameter along the top of the tunnel, on which a small electric car should run, connected by a short cable with the train, each of which should be provided with two, three or four electric locomotives of 100 horse-power each, driven by a single engineman. The dynamo-electric machines were to be run by the turbines at the mouth of the tunnel which furnished the power for compressing the air for drilling during the construction of the tunnel, and the return current was to pass through the rails. The firm was willing to guarantee that the cables would deliver to the locomotives at least 50 per cent. of the power developed by the turbines, and the cost for the apparatus exclusive of the locomotives is reported at the comparatively trifling sum of $36,000, but the railroad company was apparently afraid to make the experiment.

Another plan was to work the road by means of compressed-air locomotives, which were actually employed during the construction of the tunnel; but the experience with these condemned them for other than construction trains. The engines had extraordinarily large tenders, but with these filled with air at a pressure of 180 lbs. per square inch, besides a large store in the engine itself, they could run but about 7,300 feet. To get through, great reservoirs were established at intervals along the tunnel, and 40 minutes of time was consumed simply in taking on supplies of air in a run of little more than three miles.

It was also proposed to run the trains with electric locomotives supplied by Faure accumulators, but the accumulators alone would make about all the load that the engines could haul at a low rate of speed, as has been shown before.

The conclusion was that for the present it is best to use ordinary steam locomotives, until further improvement has been made in other motors. Care is to be taken to have a good head of steam before entering the tunnel, and the fire under full headway, without fresh coal, and shut tight, so that the passage may be made without opening the fire-box door and with little escape of the gases of combustion. So far the traffic has been light, and there is a strong current through the tunnel from south to north, and the air is said not to be very bad.

The interior of the tunnel is saturated with moisture which is taken up by the current of warm air from the south, which grows warmer during its passage. Striking the colder body of air at the north end of the tunnel, it looses its capacity for moisture, and the water in it is precipitated in the form of a quite thick mist which always hangs about the northern entrance.—*R. R. Gazette.*

MECHANICAL PROGRESS OF THE FUTURE.

Thoughtful engineers, familiar with the work which has been done in mechanics during the last hundred years, have long wondered wether it was possible to continue mechanical progress in the next hundred years as has been done in the past, and the question has been invariably answered in the negative. It is true that the popular belief is that the possibilities of progress are in all directions unlimited, and that in mechanics alone we may go on year after year without hindrance. Such is not the case. In many lines of progress the engineer sees that with the present conditions he is already close to the limit which theory places before him. The steam engine, for example, using one-tenth of the power to be obtained from the coal, is vastly nearer what theory indicates to be its limit of economy than most people imagine. Indeed some of our best engineers, doing perhaps one-half better than that, are so near the end that comparatively little is to be hoped for. Two-tenths will practically be the limit, and we have already passed one-tenth. It is true that the great field of aerial navigation is likely soon to be opened to the mechanic, and yet even there, unassisted, the mechanic alone is hardly likely to be successful. The science of the future is undoubtedly chemical, and our great discoveries and greatest progress will be in that science. Mechanics, hereafter, may expect to take a subsidiary position and be the handmaiden of chemistry. The alkali industry, for example, one of the greatest of the age, has recently been progressing with a rapidity startling to those who have given but slight attention to it. For example, during the past year a product which has not only been wasted, but a most unmitigated nuisance to the community, has been turned to account, and from it during the past year one firm alone recovered 6,000 tons of sulphur, and five English firms, during the period covered by the last reports, recovered over 17,000 tons. In such a work as this chemistry plays a leading part, and mechanics takes a secondary position.

In the great Bessemer industry chemistry and mechanics have stood side by side; chemistry in general propounding the problems and pointing the way to the chemical solutions, and calling upon mechanics to find the means for carrying the work on. In the Old World many articles which, in this country are the objects of production, or, in other words, are made especially, are there simply by-products, made incidentally in establishments whose principal business is some other more important manufacture. Not infrequently some manufacturer finds that by the introduction of a chemical process into his establishment, waste products which he has been compelled, at heavy expense, to throw away, are converted into valueable commodities. It is not beyond possibility for the user of power and the chemist to be found side by side, the chemist in his work, perhaps, furnishing the motive force of the mechanic, and possibly as a waste product. Indeed, we know of dye works where 1,000 horse-power is produced at an expense of fuel actually below the theoretical. Steam already made is run through the engine and its pressure reduced till it reaches that needed in the works. The fuel for the power is merely that needed for raising the steam 20 or 30 pounds in pressure. The cost of making the steam falls upon the dye works.

NOTES.

IRONCLAD SHIPS.

The thickest armor in the British navy *is that* of the Inflexible, one of the ships that bombarded Alexandria. It varies in thickness, in different parts of the ship, from 16 to 24 inches. The Italian Government is building two ships which will have armor 36 inches thick. The Italian ships Duilio and Dandolo have armor 22 inches thick throughout, making them, upon the whole, more heavily armored than the Inflexible. Their armament is also heavier, as they carry 100-ton guns, against the Inflexible's 81-ton guns.

AFRICAN EXPLORATION.

An expedition, under the command of Rogozinski, an officer of the French navy, is about to explore the tract of country between the Gulf of Guinea, the Chary, and the Congo. No European has ever visited this region, in the centre of which, according to the natives, there is a large lake (the Liba), from which the Chary and other rivers flow into the Bay of Biafra derive their source. Rogozinski takes seven or eight Europeans with him, and he intends to establish on Mount Cameron, at the extremity of the Bay of Biafra, a geographical and meteorological observatory.

THE EFFICIENCY OF INCANDESCENT ELECTRIC LAMPS.

A committee, consisting of Prof. George F Barker, of Philadelphia; William Crookes, of London, and others, made a series of experiments on the incandescent electric lamps exhibited at Paris last year. The following are the conclusions reached after elaborate tests, as given in the report of the committee:

1st. The maximum efficiency of incandescent lamps in the present state of the subject, and within the experimental limits of this investigation, cannot be assumed to exceed 300 candle-lights per horse-power of current.

2d. The economy of all lamps of this kind is greater at high than at low incandescence.

3d. The economy of light-production is greater in high resistance lamps than in those of low resistance, thus agreeing with the economy of distribution.

4th. The relative efficiency of the four lamps examined, expressed in Carcel burners of 7.4 spermacetti candles each, produced by one horse-power of current, is as follows: (A) At 16 candles: Edison, 26.5; Swan, 24; Lane-Fox, 28.5; and Maxim, 20.4. (B) At 32 candles: Edison, 41.5; Lane-Fox, 37.4; Swan, 35.5; and Maxim, 32.4. To double the light given by these lamps, the current-energy was increased, for the Maxim and Lane-Fox lamps, 26 per cent.; for the Edison lamp, 28 per cent.; and for the Swan lamp, 37 per cent.—*Engineering and Mining Journal.*

ALEXANDRIA'S WATER SUPPLY.

A THREATENED WATER FAMINE IN ALEXANDRIA.

LONDON, July 24.—The *News* has the following:

ALEXANDRIA, July 23.—The staff of the water-works are hard at work cleaning the Roman cisterns for the storage of water. It is a race between the falling level of the canal and the dauntless energy of the English engineers. If only water enough can be stored to tide over another month, the Nile inundation will probably sweep away Arabi's dike or rush around it, and all will be well.

THE RAMLEH WATER-WORKS.

Arabi Pasha has massed 700 cavalry with a field gun at the pumping station of the Ramleh water-works. It is supposed his intention is to destroy the station.

CONDENSING WATER.

To provide for the civil population the Chief Engineer of the Bittern has been placed in charge of the steam cotton works, where, with five boilers and two tanks, he will be able to condense 100 tons of water daily from wells of brackish water.

GENERAL INTELLIGENCE.

☞ We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.

GAS AND WATER.

WILL HAVE WATER-WORKS.—The corporation of Bellows Falls, Vt., has at last ended the question of additional water supply. Norman H. Farr recently bought of the Cheshire Provident Institution, of Keene, N. H., the pasture land near Menard's pond for $1,500, and three acres of this, with the privileges and appurtenances for overflowing, damming and piping, he conveys to the Bellows Falls village corporation for $300.

THE NATIONAL GAS COMPANY, Norristown, is full of orders for special apparatus designed for the manufacture of the Lowe process gas. The new works at Cape May were designed and built at the Norristown shops of this company. A complete set for an interior city of Pennsylvania has just been finished.

WATER SUPPLY WANTED AT YORKVILLE, CANADA.—The water-works engineer having reported that the supply was considerably less than last summer, and that unless some immediate action to remedy matters was taken the residents would be without water, a meeting of ratepayers was held on Tuesday night at Mr. Severn's residence. The chair was occupied by Mr. A. Harvey, who said that prompt steps would have to be taken in regard to the insufficient supply. It was decided that the chairman should wait upon the Corporation of Parkdale and ascertain the probable cost of supplying Yorkville with water.—*Toronto Mail.*

WATER METERS.—The city engineer and manager of the water-works of Toronto, Can., has been instructed to report at an early day the state of the water meters of that city.

THE WATER QUESTION AT GALESBURG.—GALESBURG, Ill., July 24.—The question of water-supply in this city has long been a problem that has puzzled the wisest heads to solve. Mr. W. R. Coats, a civil engineer from Michigan, has been here for several weeks prospecting and experimenting. The result was a report to the city council last Saturday night, recommending Crystal Springs Park as promising an inexhaustible supply. The city clerk was thereupon instructed to call an election, to be held Aug. 22, to vote on the following propositions: For or against purchasing the Crystal Springs; for or against issuing of city bonds for $18,000, with which to build the water-works, $12,000 having already been appropriated, and for or against appropriating $5,000, for the purpose of erecting a public library building.

WATER SUPPLY OF SWAMPSCOTT, MASS.—The people are quite jubilant over the prospect of an immediate water supply through the agency of the Swampscott Water Company, whose experiments with tubular wells in the basin of Stacy's Brook were noted a few days ago. The manager of the experiment says the directors are feeling satisfied with the yield and quality of the water and are ready to pipe the town, erect a standpipe on some lofty spot, put in a double pumping engine having a daily capacity of from 1,000,000 to 2,000,000 gallons, and erect other paraphernalia of water works. The contract for the pipe will be awarded very soon, the quality to be the Boston standard, which is claimed to be superior to that used in the neighboring city of Lynn. A 12-inch pipe will be laid from the pumping station, off New Ocean street, through this street to Burrill street, and thence in a direct line to a point beyond the Ocean House. Pipes of good capacity will be laid elsewhere. The hotel managers and many private families have been caused much trouble and expense in securing water in the past, and owners of water carts have done quite a lucrative business at times in supplying their places. To sum up the disadvantages under which the citizens have labored, it is sufficient to say that they have been put to great inconvenience and considerable cost. For these reasons they are thirsty for a modern supply, and therefore give the water company every encouragement. The present pumping station was inspected on Monday, when it was found that a pump having a capacity of 8.8 gallons per stroke was pumping 56 strokes to the minute, which was increased to 60, showing that the pumping was at the rate of over 700,000 gallons for a day of 24 hours at the former rate, and over 750,000 gallons at the latter rate. The boiler was not sufficiently large to run the pump at a higher service. The water is drawn from eighteen tubular wells sunk to a depth of thirty feet. The wells first penetrated loam and gravel to a depth of seven or eight feet, and next a bed of clay having a uniform depth of eight feet. Following this was found fine sand, and next was water gravel, from which deposit the supply is drawn. This basin, which is at about sea level, is supposed to be fed by innumerable springs within a large section of territory. The water is clear, has a nice taste, and is cool. A thermometer indicating 100 deg. was thrust into the water Monday, and in a few seconds it indicated 48°. The detailed result of an analysis of the the water is not known, but the managers say it is of excellent quality. Some samples are now being analysed in Boston. A few people think the water will be rather hard for some purposes. The company's officers believe the water will be suitable for all domestic purposes and will be pure. The supply is deemed to be far greater than would be demanded. A million gallons daily is set as the easy capacity of the works, while the consumption would not be over 250,000 gallons daily if every house in Swampscott had connection. The steady pumping has very little effect upon the yield. The wells cannot be lowered less than nine feet from the surface by the present pump. On Monday the pump was stopped two minutes, and during that time the water rose 21½ in. in the wells. Pumping is stopped at night, and on the next morning the wells are found to be overflowing. But little sand is raised by pumping. On the first day there was a bushel of the sand raised, on the second day one-half bushel, on the third day one peck, and for the past three days one-half peck altogether. Definite information as to street pipes, the position of the standpipe, etc., will be had within a few days. The officials give the assurance that the works will be pushed with all possible speed.—*Boston Journal, July 25.*

AUDUBON (Neb.) has voted to have water-works.

WATER SUPPLY AND TAXES.—The tax-rate of Orange, N. J., has been fixed at 2.66. This is the highest rate ever known in that city, but the excess is occasioned by the fact that the authorities have just completed arrangements for a new water supply.

WATER SUPPLY EXTENSION.—The Grand Rapids (Mich.) City Council has voted to submit a proposition to the people of issuing bonds in the sum of $100,000, to be used in extending the water mains.

THE construction of the Paris, Ont., water-works is to be proceeded with at once.

THE city of Negaunee, Mich., offers $25,000 bonus to any company which will provide the city with water-works.

THE Holly Mfg. Co. have recently secured contracts for pumping engines, 3,000,000 daily capacity, for Fort Worth, Tex.; also, for Austin, Tex.; engine for 2,000,000 daily capacity for Atlantic City, Iowa, and for water-works complete for Manistee, Mich., including 6 miles 7-in. pipe, 50 hydrants, and pumping engines, 2,000,000 galls. daily capacity.

TO BUILD GAS WORKS.—A company proposes to put in gas-works at Atlantic, Ia., and furnish gas at $2.50 per thousand feet.

TO INCREASE THE WATER SUPPLY.—Chief Engineer Van Buren is perfecting plans to increase Brooklyn's water supply by about 5,000,000 gallons a day, at an expense of less than $200,000.

ELECTRICITY.

THE TELEPHONE IN NEW HAMPSHIRE.—Through telephone connection has been made from Plymouth through Ashland, Meredith, Laconia and other places to Franklin. The telephone line is being extended to East Swanzey and Marlboro depot and will probably be built to the county almshouse at Westmoreland, with stations at South Village and Parkhill.

THERE is talk of putting six powerful electric lights on top of Mt. Washington.

ELECTRICITY IN EGYPT.—The electric light has been established in the forts.

THE Electric Light Company, at Fond du Lac, Wis., have decided to put in five hundred of Edison's incandescent lights for lighting private dwellings and stores.

TWENTY-FIVE electric lamps are being placed in the Mining Exposition building, at Denver, which is to open next week. Utah has contributed a block of refined silver valued at $118,000. There are three samples of high-grade ore, weighing over a ton each.

THE long deferred "lighting up" in the first district of the Edison Electric Light Company, it is now expected, will take place about the 1st of September. The district is bounded by Spruce, Nassau and Wall streets and the East River. After more than a year of steady labor all of the mains have been laid, houses and offices have been "wired" for about 14,500 lamps, and elaborate and costly machinery has been constructed in the central station on Pearl street.

A NEW TRANSATLANTIC CABLE.—LONDON, July 22.—The prospectus has been issued of the European, American, Canadian and Asiatic Cable Company. The capital stock of the company is £1,500,000. The company proposes to work at a rate of ninepence per word. The prospectus provides for the establishment of the necessary land and water communications for connecting points in Canada with New York City on one side, and for the laying of the company's cable from Canada to Europe on the other.

ELECTRIC LAMPS IN SPRINGFIELD, MASS.—There are 60 electric lamps in use in the city and each one that is burned nightly has to be put in order just as though it were an oil lamp that needed trimming. The man in charge takes out the carbons which were burned the night before, so that their points may be ground over, replacing them with others that have been sharpened. The city electric lamps are soon to be provided with globes to protect them from the wind and give a steadier light. These lamps occasionally let fall pieces of burning carbon, and people who pass under them will do well to be on their guard. Bad boys have been in the habit of lowering and raising the Court square lamp according to their own sweet will, and the company have placed the end of the hoisting rope in a lock box attached to one of the trees to end their sport.—*Springfield Republican.*

RIVERS AND HARBORS.

QUEBEC HARBOR IMPROVEMENTS.—QUEBEC, July 26.—Mr. Askwith, of Ottawa, having declined the contract for the new harbor works, Larkin, Connolly & Co., of St. Catharines, Ont., graving dock contractors, the next lowest tenderers, have put up the deposit of $10,000 required by the Commissioners before being awarded the contract. Their tender is $8,000 higher that Askwith's, which was for $150,000. They have all the plant necessary for the undertaking on the Welland Canal. The award has been referred to Ottawa for ratification.

STREETS, DRAINAGE, ETC.

TORONTO PAVEMENTS.—We give the results of bids for cedar block paving in Toronto, Canada, in the following table. The contracts were awarded on the 18th. Queen street will cost about $130,000, and the other streets $50,000. Yonge street has just been finished with cedar block, stone curb, roadway 42 feet wide; cost $60,000. The bidding for Queen street and others was very close, so that the figures awarded give a good indication of all the others.

ABSTRACT OF TENDERS FOR WOOD PAVING QUEEN ST., TORONTO, CANADA.

Names of Successful Bidders.	Section.	Pavement—per Square yard.	Wood Curbing—per Lineal foot.	Moving Tracks—per 100 Lineal feet.	Crossing Plates—100 lbs.	Curbing.
John McBean	River Don to Parliament street	$1.16	25	$18.00	$2.50	Wood.
John T. Pearce	Parliament to Jarvis	1.23	25	30.00	3.50	"
John T. Pearce	Jarvis to Yonge	1.24	24	30.00	3.50	"
Richard Dennis	Yonge to Simcoe	1.15	26	22.50	2.90	Stone.
Richard Dennis	Simcoe to Brock	1.16	24	22.50	2.90	"
A. W. Godson	Brock to Bathurst	1.28	25	20.00	2.50	"
Richard West	Bathurst to Strachan	1.18	70	18.00	2.75	"
Richard West	Strachan to Dundas	1.17	27	18.00	3.00	"
Richard West	Dundas to Railway Crossings	1.15	26	15.00	3.00	Wood.
Richard West	Brock street. King to Queen street	1.05	27	15.00	3.50	"
Richard Dennis	Brock street. King to Front street	90	25	....	2.75	"
Richard West	Dundas street. Queen street to bend	1.10	26	15.00	3.50	"
Richard Dennis	Strachan street. Queen to Conway street	93	26	....	2.50	"
A. W. Godson	Charles street. Church to Jarvis street	1.04	27	....	2.50	"
A. W. Godson	Berkeley street. Wilton avenue to Gerard street	84	27	....	2.50	"
John McBean	Lane. Between Front and Esplanade sts., Yonge to Scott sts	1.14	1.00	....	....	"
Geo. Farquhar	Lane. Bet. Yonge and Jordan sts., Melinda to Wellington sts	*2.75 †3.00	85	....	....	" "

* Stone.
† With tar composition.

SANITARY IMPROVEMENTS.—Blakeslee & Sons have just finished filling the meadow near the Consolidated depot at Meriden, Mass., a job costing $10,000. The same firm have a $10,000 contract for paving certain streets at Bridgeport.

THE STRATHROY (Canada) Town Council has asked for tenders for a number of asphalt sidewalks.

A NEW HAVEN PROJECT.—New Haven looks with some favor on a project to spend $1,000,000 in narrowing West River into a canal, constructing a long sewer besides, and laying out a boulevard over the marshes.

ABOLISHING NARROW TIRES.—Davenport's City Council has passed an ordinance against the narrow-tired wheels that were ruining its macadamized streets, taxing all carrying over 3,500 pounds.

THE SOUTH MILL POND NUISANCE.—At a meeting of the Aldermen of Salem, Mass., the Committee on South Mill Pond reported a plan for abating the nuisance there existing as follows: That the bottom of the culverts or arches under Mill street be deepened to about 6½ ft. below high water line, which would require rebuilding the masonry; that the bottom of the Mill Pond, from Mill street to the culvert under the Eastern Railroad, be excavated 20 ft. wide and to a depth of 6½ ft. below high-water line; that a canal 10 ft. wide be built from the eastern culvert, under the Eastern Railroad, to the railroad culvert, near Castle Hill, while the culvert be largely improved; also that the pond bed be deepened to a distance of 400 ft. south of Mill street, and that other minor pieces of work be performed. The gross cost would not exceed $33,075. The Eastern Railroad has submitted propositions, in which that company agrees to make improvements at the Mill street outlet, rebuild the two railroad culverts and dredge the pond from Mill street to the first culvert—all this, providing the company shall be freed from further responsibility with the pond matter. The Aldermen authorized the contract to be made as above, provided a slight modification can be made in the Railroad's proposition about the improvement at Mill street. The bill was sent down to the Council.—*Boston Journal.*

Grading.—The St. Paul, Minn., board of public works has reported favorably on grading Seventh street. The estimated cost is $160,000.

Paving.—It is estimated that the cost of paving already provided for in Springfield, Ill., by ordinance will be $93,458.

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RAILROADS.

Nova Scotia Railways.—The engineers of the short line railway have completed the final survey of the railway from Oxford to Pugwash, N. S., a distance of about eighteen miles, shortening the previous survey some two miles, and getting a very good line. They have commenced a survey from the junction of the Pugwash road towards New Glasgow, N. S., to meet the other surveyors. Col. W. S. Greene, Chief Engineer, is expected to return from New York in a few days to commence the construction of the road already located, and it is understood to be the intention of the company to proceed with the work as rapidly as possible.

The Rail Market.—Steel rails are quiet, with little new business reported. Quotations continue at $48 to $50 per ton at mill. Iron rails are dull, and only small sales are reported. Quotations are $45 to $48 per ton at mill, according to section, but it is probable that large orders could be placed a little lower. Spikes are active at $3.10 to $3.15 per 100 lbs.; fish-plates, a little lower at $2.50 to $2.70; track-bolts, $3.75 to $4.25. Old iron rails are quiet with few sales reported. Quotations are $26 to $27 per ton in Philadelphia for tees, and $28 for double-heads.

Prices of Scrap.—Pittsburgh quotations for scrap iron and steel are as follows: Old car wheels, $26 to $27; cast borings, $15 to $16; crop ends, $26 to $26.50; wrought turnings, $20 to $22; No. 1 wrought scrap, $27 to $29; old car springs and steel axles, $38 to $40. Quotations for cast iron and crop ends are per gross ton; for wrought iron and steel, per net ton.

Grading Commenced.—The work of grading the railroad from Bridgton to Hiram, Maine, is being actively pushed, work having been commenced last week.

Smithville and Morehead, N. C., are now connected by rail.

The Cincinnati, Van Wert & Michigan Railroad, now constructing through the western tier of counties in Ohio, is being rapidly extended toward Cincinnati. It is now in operation from Paulding, the county seat of Paulding County, through Van Wert to Shane's Crossing, in Mercer County — some 32 miles. This part of the road passes through the largest body of timber now standing in Ohio, and is doing a large and profitable business. It is expected that the track will be laid to Greenville this fall; from Greenville a very good connection will be made via Dayton to Cincinnati.

New Style of Coaches.—The Pennsylvania Company are now building all their passenger coaches one foot narrower than the ordinary pattern, reducing the width by making the alley more narrow. The object is to make the car lighter and to lessen the resistance. The pattern adopted reduces the weight 5 per cent., and the resistance fully 10 per cent., yet the coach is just as convenient and rides easier than the ordinary wide coach.

The amount of coal consumed annually on the New York Central road, between Albany and Buffalo, is from 800,000 to 900,000 tons.

The New Denver Cut-Off of the Burlington.—The surveyors recently sent out by the managers of the Chicago, Burlington & Quincy to locate a line from some point between Hastings and Kearney to Arapahoe, Neb., in order to shorten its lines to Denver, as the present line from Hastings to Red Cloud forces the road to make a considerable detour to the southward, have completed their work and report in favor of a short cut from Kenesaw, on the Kearney Branch, to Arapahoe. The new link will be 80 miles long and will shorten the distance between Chicago and Denver 25 miles. With the completion of this new line the Burlington will have the shortest line to Denver from Chicago by about 30 miles. Construction on the new cut-off will commence next spring, it being too late in the season to commence work now.

The Road Will be Built.—Montpelier, Ind., July 24.—The Bluffton & Union City Railroad Company has negotiated a sufficient loan with Eastern capitalists to build the entire line, and work will commence immediately.

Work has been begun on the Wisconsin, Iowa & Nebraska Railroad near Waterloo. Grading is also being done near Marshalltown, and the two forces are working toward each other. It is expected that cars will be running between Marshalltown and Waterloo before the end of the year.

Track-laying on the Springfield & Memphis road, between the crossing below Walnut Ridge, Ark., and Black River has begun.

New Kansas Companies.—Charters have been filed with the Secretary of State of Kansas for the following new railroads: The Atchison & Southwestern Railroad Company, with headquarters at Atchison; capital stock, $3 000,000; directors, J. P. Brown, J. H. Beeson, C. C. Burnes, J. P. Pomeroy, Henry Low, F. D. Mills, E. B. Purcell and Philip Zepin. This road is to run from Atchison in a southwesterly direction, through the counties of Atchison, Jackson, Pottawatomie and Riley, to some point on the Kansas River, a distance of about 100 miles. The Blue River Railroad Company; the road is to run from Manhattan, Riley County, in a northerly course along the Blue River, through the counties of Riley, Pottawatomie and Marshall, a distance of about 60 miles; capital stock, $1,000,000. The business of the company will be transacted at Atchison, and the directors are F. D. Miles, J. H. Beeson, Henry Low, Frank Schweerdt, John McPherson, L. R. Elliott and E. B. Purcell.

Grading Completed.—A Neenah (Wis.) dispatch says: "The Milwaukee & Lake Winnebago Railroad Company has been laying rails south of Neenah. Trains will be running between Neenah and Fond du Lac inside of thirty days, providing the right of way through Oshkosh is secured by the time the rails are laid that far. The grading is all completed."

Over the St. Lawrence.—The Atlantic & Northwestern Railway has acquired the right of way to span the River St. Lawrence above the Lachine Rapids. The water is deep there, but the distance is less than in some localities.

The Canadian Pacific.—A dispatch from Winnipeg has been received to-day by Messrs. J. S. Kennedy & Co., agents of the Canadian Pacific Railway Company in this city, from Mr. George Stephen, President of the company, in which he says: "I have just returned from the end of the track, which is now 295 miles west of Winnipeg. Contractors are laying from three to four miles a day, and, barring accidents, I have now no doubt of our completing 500 miles of main-line track this season, bringing the locomotive 50 miles west of the Saskatchewan River by December next. Crops are looking splendidly, and traffic on the part of the line in operation will foot up this year about $2,000,000, exclusive of the earnings on the Eastern Division."

Saratoga, Mt. McGregor & Lake George Railroad.—Gauge 3 ft. Length 10½ miles. Work begun March 17 last. First train through to end of line, July 16. Road opened to public on the 17th. Difference in elevation of termini, 800 ft. The whole work has been carried forward under the direct superintendence of John McGee, Engineer and Superintendent. The two engines now on hand are intended for the mountain grade only, where sharp curves make hard pulling and require moderate speed. The engine for use between Saratoga and the heavy grades did not arrive in time for the opening of the road as was intended. This one will draw to the foot of Mt. McGregor a train that will require the power of the two mountain engines to take it to the top of the mountain. The two mountain engines as yet fall short of the performance promised by the manufacturer. It is expected, however, that as the track improves and the engines become worn down to smooth working that they will increase their effective power considerably. On the mountain grades 24-degree curves (of 280 ft. radius) are frequent. A steady grade of four ft. rise to the hundred (211 ft. per mile) is maintained except at the beginning of the mountain grade, where it was necessary to adopt a grade of 232 ft. to the mile for a distance of three-quarters of a mile. The work of the mountain was difficult, slow and expensive. Several very large trestles were needed, some of which are 35 to 40 ft. high up to 830 ft. long, and others on sharp curves. In the first 2½ miles of line from the summit only one-half (as the crow flies) of distance is made from the starting point, the two miles of extra distance being developed to make the rise needed to reach the top of the mountain. It is to the credit of the manner in which the work has been carried out that notwithstanding the difficult and dangerous character of much of it and the hurry in doing it that time has been taken to do the work safely. Not a fatal accident, nor even a serious one, has occurred in its prosecution.

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CANALS.

Connecting the Rhone and Loire.—According to *Engineering* the proposed connecting of the Rhone and Loire rivers (France) by a canal contemplates the employment of Captain Eads' plan of carrying boats up two long inclines by means of railways. To prevent injury to the boats, they will be floated in iron cisterns resting on railway trucks. The trucks will be helped up the incline by the gravity of barges in an opposite direction.

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CONTRACTS.

Lafayette, Ind., July 19.—The County Commissioners are having prepared a transcript in the court-house case, with a view of trying again in the Supreme Court. They last week invited bids for the work of completing the court-house. The only question involved in the appeal, outside of the expense, is whether or not the County Commissioners can go on and build the court-house without advertising for bids. They claim they can—the County Court said they could not.

The village of Escanaba, Mich., is to build a new court-house. The bids are advertised to be opened yesterday, the 28th.

Paterson Improvements Stopped.—Judge Dixon, of Jersey City, has granted a supersedeas stopping all the proposed permanent street improvements in Paterson, for which contracts were about being executed, and certioraried the matter to the November term of the Supreme Court to decide the legality of the proceedings that had been taken. The proposed improvements were to cost between $40,000 and $50,000, and the contracts had all been awarded, but not signed. The grounds of the application were that the proceedings were not legal, on account of not conforming with the wording of the city charter.

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CONTRACTS LET.

Clarke, Reeves & Co., at Phoenixville, Pa., have the contract for the new bridge over the Susquehanna at Lewisburg, Pa., on the Philadelphia & Reading's new line to Williamsport. It will be 2,400 ft. long, in 10 spans, and is to be finished by the end of November.

The Central Bridge Co., of Buffalo, N. Y., has the contract for the bridge over the Delaware River at Portland, Pa., for the Pennsylvania, Slatington & New England road.

A Building Contract Let.—The contract for building the foundry and store-house of the Holyoke, Mass., foundry company has been given to Lynch Bros. for $16,087. The buildings are expected to be ready for use by Sept. 21. Lynch Bros. have sublet the wood and iron work to F. F. O'Neil.

A Paving Contract Let.—The contract for paving Main street, Holyoke, Mass., from Dwight to Appleton, was awarded yesterday to Daniel O'Connell at the rate of $2.60 a square yard, the material to be Cheshire granite. There were seven bids.

A Bridge Contract Let.—The Cleveland (O.) *Leader* says: A contract has just been awarded to the Smith Bridge Company, of Toledo, by the Cleveland, Akron & Columbus Railway, for the erection of five iron bridges, one near Hudson, one near Akron, and three between Akron and Orrville. These bridges are designed to carry the heaviest freight engines built.

Town Hall at Doylestown, O.—The bids for building the Town Hall were opened Friday, June 30th. J. C. Ealing's was the only bid for brick work—$8.25 per thousand and to furnish brick in excess of those on hand at $6 per thousand. W. G. Biglow's was the only bid for woodwork—$2,450. Jacob Shook's bid was the lowest for masonry—$450. Jacob Dies' bid was the lowest for plastering—$181. J. J. Hower's bid was the lowest for roofing and spouting—$190. No bid was put in for painting.

Boston Brick Contract Let.—The Committee on Improved Sewerage has made a contract with the Brewer Brick Co. of Bangor to furnish 1,000,000 bricks during the coming fall, at $9.50 per 1,000. Between 20,000 and 30,000 brick are used each day in the lining of the tunnel to Moon Island, and it will take about eight months to complete the work.

The contract for constructing the steel barbed wire fencing on the eastern division of the Canada Atlantic Railway has been awarded to Mr. Lockie Wilson, of Glengarry. This contract embraces 150 miles of fencing and about 1,000 gates.

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BUILDING.

Toronto, Can., wants a new city hall, as the present building is inadequate for its requirements.

Building Operations in Holyoke, Mass.—Some of the contractors are offering to lay brick for $9.50 a thousand and cannot find employment for their men at those figures, which leads many to suppose that the price will drop to $9 a thousand before fall. As a consequence, quite a number who had determined not to build this season are again talking of erecting houses, and it would not be strange if a brisk business was done in building before the snow flies. Some of the prominent builders have very few jobs on hand, and as soon as these are finished it will be difficult for them to keep their men busy.

Westpoint, Va., is to have a large hotel.

The Iowa capitol, begun in 1871, is nearing completion. Estimated cost, $1,500,000; actual, $2,500,000—and it is to have a gilded dome.

The New Union Depot at Reed City, Mich., is to cost $14,000.

Church.—A $10,000 Methodist church is to be built at Ridgefield, Conn.

Price of Bricks in Toronto, Canada.—A writer in the *Globe* states that since the spring supply of bricks came prices have steadily decreased and are now as low as they have been for years.

Sioux County, Iowa, is to have a $6,000 stone jail.

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LABOR.

Wages, Prices and Profits in Mass.—In the current Princeton *Review*, Carroll D. Wright makes the deduction from an elaborate comparison of wages, prices and profits in Massachusetts from 1860 to 1881 that, covering the whole period of 21 years, there has been an average increase in wages of 31.2 per cent., and in prices of 41.2 per cent; in other words, that the workingman has suffered a reduction of 10 per cent. in the purchasing power of his wages; but that this reduction is only temporary, the general tendency being to elevate wages, which tendency has steadily increased for the past 100 years. Mr. Wright believes that a too rigid economy reacts upon consumption and so cripples wages; that machinery on the whole favors wages; that railroads and other capitalized developments of transportation are also beneficial to the wage-receiver, while trades-unions and co-operative production are not; and that in the end the workingman must turn to himself for the only true solution of the financial difficulties, by becoming something more than a machine, and putting himself at his best as to skill, faithfulness and temperance, and temperance in the largest sense of lopping off all superfluous and harmful habits and expenditures.

Chinese Laborers.—There are 4,050 Chinamen employed on the Canada Pacific Railway work in British Columbia, and that number will be increased to 6,000 in August.

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BRIDGES.

The work on the addition to the Philadelphia Bridge Works, Pottstown, Pa., is being pushed forward as rapidly as possible. A large hammer is to go into the blacksmith shop. Among contracts on hand is one for three hundred dozen axles for the Philadelphia & Reading Railroad Company.

The Dominion Bridge Company will, according to the *Toronto Globe*, have its head office in Toronto. The company comprises Messrs. Job Abbott, civil engineer, and Phelps Johnson, civil engineer, both of Toronto; Angus Thom, Montreal; Henry Macfarlane, contractor, of Stratford, Ont.; and Luke Lyman, Probate Judge of Northampton, Mass. The capital stock is $500,000.

The proposed bridge between Moorhead and Fargo, D. T., is in a fair way of being built.

Work on the big bridge across the Missouri at Bismarck, D. T., is progressing rapidly.

REPORT OF THE ADVISORY COMMISSION UPON DIFFERENTIAL RATES.

PRELIMINARY.

In January, 1882, the undersigned were notified that they had been selected by the New York Central & Hudson River Railroad Company, W. H. Vanderbilt, President; the New York, Lake Erie & Western Railroad Company, H. J. Jewett, President; the Pennsylvania Railroad Company, G. B. Roberts, President, and the Baltimore & Ohio Railroad Company, John W. Garrett, President, to act as an Advisory Commission upon "the differences in rates that should exist, both eastwardly and westwardly upon all classes of freights between the several terminal Atlantic ports," and to report upon the same.

Accepting the appointment, the undersigned met and organized as a Commission, at the City of New York, on February 13, 1882, by designating Mr. Thurman to act as Chairman, and selecting Mr. Thomas C. Moore, of Indianapolis, as Secretary. On conferring with Mr. Albert Fink, who on that occasion represented the several railroads named, we were informed that it was not the purpose or desire of the railroad managers to take part in the proposed inquiry after setting it on foot; but that they proposed to leave it exclusively in our hands, in the expectation, however, that other parties interested in the problems of railroad transportation would make before us a full showing of the facts supposed to have a bearing upon the question, and that we would then express our opinion, uninfluenced by the wishes or interests of the railroad companies. The managers informed us, however, that they held themselves ready to furnish any such information as might be peculiarly within their knowledge, at any time when we might call for it.

Having this understanding of our commission, and desirous of acting intelligently, and with full information, we caused circulars to be sent to all the commercial organizations of the cities of New York, Philadelphia, Baltimore, and Boston, and to such like organizations in the interior as it was thought would be inclined to respond, inviting them to appear before the Commission and present their views; and whenever a desire to be heard was expressed by any one of them, time and place were designated for the purpose.

From the Produce Exchange, the Board of Trade and Transportation, and the Chamber of Commerce of the City of New York, and from the corresponding organizations of the cities of Philadelphia and Baltimore, letters expressive of a desire to be heard were received, and public meetings were accordingly held in those cities, at which the question referred to us was very fully considered and discussed. For the purposes of such discussion, we found that in every instances careful and thoughtful preparation had been made, and the arguments, either in full or in substance, were put in print for our subsequent review. Statistics were also collected for us, so far as was thought important. Under the guidance of the commercial bodies, we also visited and inspected the railroad terminal facilities, under circumstances most favorable to a full understanding of the manner in which they concerned the general subject.

The leading commercial organizations of St. Louis, Louisville and Toledo also appeared before us at public sittings held in those cities respectively, and presented their views in print, supplementing them with oral arguments and explanations.

We were also favored at Philadelphia with discussions by representatives of the Board of Trade of Newark, New Jersey, and at St. Louis with the views of the Board of Trade of Indianapolis, presented by one of its members. The Chamber of Commerce of Cincinnati communicated its views to us in formal resolutions, without deeming it necessary to request public sittings in that city, and single individuals, not representing any formal organizations, have also in some cases been heard. We also sought and obtained information independently wherever we have found it available, and have made use of the published reports of the railroad companies for that purpose. Our endeavor has been to view the subject from the standpoints of the various interests concerned, and to reach a conclusion that overlooked the just claims of no interest and no locality.

THE QUESTION.

The subject referred to us is that commonly spoken of under the designation of "differential rates." In the reference, however, and in the paper which follows, the term is made use of in a somewhat restricted sense, being applied not to the differences in rates generally, or as between the several classes of freight as they are arranged in the tariffs of freight charges, but to the differences in rates which are made by the railroad companies as between the several Atlantic seaport cities, and the interior points where the freights are taken up or delivered. It appears that the four railroad companies mentioned, and which, with the Grand Trunk of Canada, are commonly called the trunk-line roads, have generally been accustomed to make higher charges for the transportation of freights between New York and Boston, an eastern *termini*, and the leading towns of the interior, than between Philadelphia and Baltimore and the like towns; and that at the present time they seem to agree in the policy and propriety of making these differences. An idea of the extent of the differences is indicated by the statement that, taking the charges for the transportation of eastward bound freights from Chicago to New York as the standard, the charges to Boston are made the same, and those to Philadelphia two cents, and too Baltimore three cents per 100 lbs. less. On westward bound freights the differences are not uniform, but are made higher in the case of those classes of property which are rated highest in the freight tariffs. As between the seaboard cities and St. Louis, Cincinnati, Toledo and other Western towns, the rates are proportioned to the Chicago rate according to mileage. This is the existing rule or practice.

Whether it is right or proper to make any such discrimination in the charges for the transportation of property between the Atlantic cities and the cities of the interior, and if so, to what extent, is the question that we understand was referred to us, and nothing more. We, therefore, limit our discussion to that question, and pass by many subjects of interest in railroad transportation that were more or less touched upon in the public discussions which took place in our hearing, but which can interest us only as private citizens. Whatever opinions we or any of us may have respecting controverted questions in railroad policy and railroad management, which do not fall within the scope of our present inquiry, it would not become us to intrude them into this discussion.

THE PARTIES CONCERNED.

Although the invitation to us came from the trunk-line railroad companies, we have not understood that this was because the subject was one over which they had rightfully any exclusive authority. It is, indeed, a subject with which they, first of all, are called upon to deal, for they and their affiliated roads enforce the charges which come under consideration, and establish the differentials if any are established at all. But the railroads constitute a single class only of the many whose interests may be effected, and it may appear, perhaps, that they are not the class most largely concerned. In all the discussions before us it has been assumed that the people of Boston, New York, Philadelphia and Baltimore, and especially all those who are engaged in the exchange of commodities with the interior and with foreign countries, are largely interested, and that their prosperity is to some extent involved in the relative adjustment of rates. The railroads of the interior, which act as feeders to the trunk lines, and divide with them the charges on freights moved between the interior and the seaboard, are also interested to the extent that the differentials affect their proportion of the charges. We have found also that the people of the interior consider their interests to some extent involved in the question; and they certainly are concerned in having such tariffs of charges upon the roads over which their traffic is conducted as will give them the advantages of any and all the Atlantic markets, without subjecting their dealings with any one of them to unfair conditions or burdens. It is therefore evident that the question is one of very general interest; and it may almost be said that the question of relative equality of rates, as between Chicago and the Atlantic ports, when those between the other Western towns and the same ports are measured by them, is one of national rather than of local concern.

THE SITUATION.

Three distinct views of the differential rates were taken and urged before us, which may be shortly stated as follows: The New York view that the differences made in the rates in favor of Baltimore and Philadelphia were wholly wrong, and should be abrogated; the Baltimore view that the differentials were right in principle, but if anything too small; the Pennsylvania view that the differentials should continue, but that they ought not to discriminate as between Philadelphia and Baltimore. In the interior we encountered much difference in opinion, but no views distinctively peculiar.

The discussion was opened at New York, where it seemed to be assumed that the parties chiefly concerned were the three cities of New York, Philadelphia and Baltimore, and that the differentials operated to build up the business of the last two to the prejudice of that of New York. On this assumption it was then said they were unjust, and that it was the duty of the New York railroads to force their abrogation. It was also assumed that two of the trunk line railroads were peculiarly New York roads, whose managers ought to be expected to labor especially in the New York interest, and to enter into the rivalries of that city, so far at least as might be necessary to protect the commerce of New York against injury through the more favorable rates which might be offered by the Philadelphia and Baltimore roads to the people of those cities respectively. At Philadelphia a somewhat similar view was taken of the obligation of the Pennsylvania Railroad to protect Philadelphia interests, and at Baltimore a corresponding protection appeared to be looked for at the hands of the Baltimore & Ohio Railroad. Thus the several trunk-line railroads were spoken of as New York, Philadelphia and Baltimore roads respectively, and claims of a local nature were made upon them as being such roads.

Nothing, however, in our investigation of the subject has struck us more forcibly than the fact that the growth of railroad business has been such as to take from the several trunk-line roads nearly all of purely local character which they formerly possessed. The time appears to have gone by when the interests of any one of them can be concentrated upon and bound up indissolubly with the interests of any one city, so as to constitute it either the dependent or the champion of that city as against the rest of the Union, or even as against any other commercial center of the Union. The arms of every one of these roads reach out in every direction to embrace and gather in the business of the country, and to distribute impartially according to need and demand. States and cities have called particular railroads into being, but they cannot circumscribe their operations, or make exclusive appropriation of their benefits. Once constructed, they belong to a public which pays little regard in business matters to State lines; and business reasons, which have general influence and force, control their operations, in spite of local sympathies or desires. It is true that two of the trunk-line railroads—the New York Central & Hudson River and the New York, Lake Erie & Western—hereinafter spoken of as the Central and the Erie respectively—find the largest share of what is called their through business directed to or originating at the city of New York, and it may be that their managers desire to bring to that city all the business they can control. In common parlance, there is certainly nothing misleading in speaking of these two as New York roads; for the major part of their interests center in New York, and whatever benefits or injures the business of New York, must, to some extent, benefit or injure them also. But these roads do not refuse freights to Baltimore, Philadelphia, or Boston; on the contrary, they enter into competition for them, and through the assistance of affiliated roads, endeavor to make it for the interest of the people of those cities to avail themselves of their facilities in the transportation of goods and supplies. They thus make themselves part of a system of competitive roads, which offers to the business community of every Atlantic seaport a choice of traffic routes and traffic agencies, and they solicit business on the necessary understanding that they shall respect the just rights and claims of all localities, and not sacrifice to New York the interests which are confided to them elsewhere.

It is also not misleading to speak of the Baltimore & Ohio Railroad as a Baltimore road, for its interest, in the main, center in the city of Baltimore; its bonds and stocks are supposed to be mainly held or controlled there, and its traffic is mainly between that city and the interior. But this road, no more than the New York roads, consents to stand apart from the railroad system of the country, as a road limiting its business to a single Atlantic terminus, and declining general competition. On the contrary, it solicits business at the seaport to the north of Baltimore; and that its efforts in that direction have a fair measure of success is evidenced by the fact that in the year 1880, it carried, of the westward-bound freight moved by the trunk line roads from New York, more than eight per cent., from Philadelphia more than nine per cent., and from Boston about five per cent., and these proportions are fairly representative of the general run of its traffic. These facts are sufficient to show that neither the New York roads nor the Baltimore road are so exclusively linked to the business interests of those cities respectively, as to be either unable or unwilling to share in or contribute to the prosperity of rival cities. And it is now publicly said, and seems to be understood, that the Baltimore & Ohio is seeking to obtain an independent line into New York, that it may make its competition at that point still more active and efficient.

It certainly cannot be claimed, with much appearance of plausibility, that the Pennsylvania Railroad is the road of any particular city. The company which owns it is indeed a Pennsylvania corporation, its offices are in the city of Philadelphia, its stocks and bonds are largely held there, and perhaps not largely held elsewhere in this country, and it is not improbable that the feelings and sympathies of those who manage its concerns would incline them to desire specially the growth and prosperity of Philadelphia above other places. But the road has its eastern terminus, not in Philadelphia, but on the harbor of New York, where it has made large and costly preparations to compete with the Central and Erie for New York business. That it does compete with those roads successfully is shown by the enormous amount of freight which it moves from and carries into that city, and by the fact that the merchants of New York have come to look upon it, with entire justice, as one of their most important channels of communication with the west. In the year 1880 this road took out of New York 26 per cent. of the west-bound freight carried by the trunk roads, and delivered to it nearly 20 per cent. of the east-bound. While thus successfully bidding for the custom and favor of New York, it is plain that the Pennsylvania Railroad cannot antagonize the interests of New York unfairly, and must refrain from any attempt to subordinate them to the rival interests which it also endeavors to serve. It is a necessary condition of its competition for the trade of New York, that it shall make its services beneficial, and that it shall offer facilities which are not surpassed by those offered by other roads. But the Pennsylvania also, through its association with the Northern Central, competes with marked success for the trade of Baltimore, and took away from that city in the year 1880 23 per cent. of the west-bound freight carried by the American trunk line roads. Its share in the east-bound freight was still more considerable, being 40 per cent. What is said of its relations to New York business may therefore with equal truth be said of its relations to the business of Baltimore, it must hold itself above the rivalries of locality, and assume the attitude of an impartial carrier, desirous of the favor and custom of the whole country, and willing and anxious to serve all localities on such terms as are relatively equal and substantially just.

It is not likely that this reaching out of all the trunk line roads to compete with each other in the several Atlantic cities was contemplated when the roads were originally constructed; but as the several lines have pushed their connections in the West in competition, it has been found desirable for each to offer to its patrons the advantages of as many markets as possible, and to carry for them, without breaking bulk, whatever they have had for carriage in an eastward or westward direction. Competition has thus made roads national which were once local, and it is vain to expect that so important a subject as that of differential rates will be settled on the local preferences or prejudices of those who may have authority in railroad circles. It must, therefore, be settled either arbitrarily, by the fiat or agreement of the transportation companies, or it must be determined by some underlying principle. We agree with what was said at the New York discussions and elsewhere, that any arbitrary adjustments in disregard of such principles as would naturally influence prices of transportation when untrammelled, would not, could not and ought not to be upheld. There should be—and as we think there must be—some principle by which to determine such a question, or perhaps two or more principles acting upon and qualifying each other.

It has been assumed in the discussions we have listened to, that business would be invited to a city by low rates upon its railroad lines, and that the prosperity of the city would bear some relation to these rates. How far this assumption is likely to be well founded, we, of course, have no more means of judging than has the general public. But the fact that each of the trunk-line roads has its relations to all the cities, and each city recives benefits from all the roads, is sufficient to suggest some question, whether low relative rates and large relative business will necessarily go together. Though it is true, as we think and have said, that all the roads which compete for the business of a place must treat its interests fairly, and not subordinate them to the interests of rival places; yet it must be expected that they will at all times have primarily in view their own interests, and that their zeal to procure business will bear some proportion to the anticipated profits. If New York business is most remunerative, it will be sought most eagerly; if not, the railroad managers will direct attention to that which is. Reducing the New York rates relatively to those of Philadelphia and Baltimore seems, therefore, to invite the roads to favor particularly the business of the two cities last named. Establishing differential rates in favor of Philadelphia and Baltimore holds out inducements to the railroads to favor the New York trade. The Pennsylvania Company may be expected to desire to carry freights past Philadelphia to New York if it can be paid for the additional haul, but to prefer to leave them in Philadelphia, if for the considerable distance from there to New York it will be paid nothing for the transportation. Thus what each city asks, appears to have some tendency to enlist the selfish interests of the railroad companies against it. We mention this among other circumstances affecting the question, without deeming it necessary to remark upon it further.

THE PRINCIPLES THAT SHOULD CONTROL.

It seemed to be taken for granted, in the arguments presented to us, that the existing differentials had not been determined on any principle, but that they were the result of a compromise between the railroad companies, whereby they had purchased peace between themselves. Three different principles, however, were suggested by different parties, as those which should control, and these found advocates in different localities, according as, it was thought, those localities would be favored by their operation respectively. These three principles may be designated respectively: the distance principle, the cost principle, and the competitive principle. It is, however, proper to say that those who advocated the first and the second of these principles generally agreed that the third should not be discarded; but that it had its legitimate place, and must have its legitimate influence also. Brief notice will be taken of these three principles respectively.

THE DISTANCE PRINCIPLE.

It was contended by the commercial representatives of Philadelphia and Baltimore, that freight charges on like classes of freights between the interior and the seaboard cities ought to be proportioned to distance. We understood them to mean by this that the shortest line from Chicago to each of the Atlantic cities should be taken as the standard for measuring the freight charges between Chicago and that city, and that the charges for all the cities should then be determined by the mileage. By referring to the accompanying note, it will be seen that if the mileage standard were adopted, the freight charges between New York and Chicago would be about 10 per cent. greater than those between Philadelphia and Chicago, and about 10 per cent. more than those between Baltimore and Chicago. Those between New York and Cincinnati would be about 28 per cent. more than between Philadelphia and Cincinnati, and about 38 per cent. more than between Baltimore and Cincinnati.* According to the average rates on grain and provisions this year, the differentials have only been about 6⅔ per cent. in favor of Philadelphia, 10 per cent. in favor of Baltimore, and the distance principle would, therefore, on an average, increase them greatly. It was urged, therefore, that it was by this principle that the several roads constituting a competing line are accustomed to apportion their joint charges, and that these very trunk lines adopt it in dividing the charges upon through freights with the roads from which they receive the freight, or to which they deliver it. The New York representatives, on the other hand, contended that the distance principle could not with any justice control, for the reason that distance does not measure either the cost or the value of the service; so that if adopted as the standard of charges, it would be an arbitrary standard, and the element of equity in the rates would be disregarded.

If there were between each of the Atlantic cities and the interior towns only a single line of railroad communication, some of the difficulties in the way of the application of the distance principle, which are now obvious, would be wanting. But, as has been said already, every one of these cities has several lines, and would be content with no less. The supposed distance principle ignores this fact: selecting the shortest line to each city, to the disregard of the rest, and estimating the charges in proportion to its length. It might thus happen that the charges on freights from Chicago to the several seaboard cities, with all their roads taken into the account, would bear no proportion whatever to the distance; and it is certain that as between the roads serving the same city, the supposed principle could not be applied at all, for they, irrespective of distance, must conform to the lowest rates. The distance apportionment would, therefore, not be an apportionment of principle, but only of expediency; and whether expedient or not, must depend somewhat on other considerations, which present themselves in the practical administration of railroad affairs.

It cannot be said, however, that distance is a circumstance without value in the determination of railroad tariffs; it is, on the other hand, one of much importance. Nearness to the producers and consumers of the articles which it handles is a great advantage to any city; and so far as the rivals of New York are possessed of this advantage, they are justified in expecting that it will be recognized. But the value of this advantage is a question that must be determined with many other things taken into the account, and can only be fully solved in the tests of competition. The general fact now is, that distance does not determine railroad charges, and that where competition is most active it influences them the least. The distance principle does not, therefore, stand the test of competition, and so far as we can percieve, there is no possibility of establishing it except by subordinating competition altogether to it. But to do this would require an exercise of arbitrary authority which we do not understand those who advocate the distance principle to advise or desire. We must conclude, therefore, that distance cannot supply for us the controlling principle, and that its proper influence upon transportation charges cannot be determined either arbitrarily or as a matter of antecedent computation or estimate.

THE COST PRINCIPLE.

New York parties who rejected the distance principle were inclined to favor the grading of rates by the cost of service; and if this were done, they claimed that the differentials would disappear altogether. Cost of service is here employed as synonymous with the phrase cost of moving freight, which is most commonly used. The latter phrase, however, is used in two very different senses, which it may be important to distinguish, in order to avoid misconception. Railroad companies use the phrase for their own purposes when making reports to their stockholders or for the public under the requirements of state laws. In such reports cost of moving freight will be understood to be the actual outlay by the railroad company in moving its freight over a completed and equipped road. This outlay will embrace the cost of fuel, the compensation to the regular freight agents, to freight solicitors, if any, to the servants employed to handle the freight and govern and move the trains. It must also embrace the necessary expense of keeping good the freight equipment, and it should include a fair proportion of all such expenses of the company as are incurred for the freight and passenger traffic in common, such as repairs of track, taxes, official salaries, legal expenses, office expenses, general advertising, etc. To all these must be added the cost of insurance against losses to freight and freight equipment by casualties of all descriptions, or of making good such losses. If all these items are added together, and the sum total is divided by the number of tons of freight moved one mile upon the road, we have as the result the average cost of transporting a ton of freight for one mile of distance.

The report which gives these items will also give others that, as between the railroad company and its patrons, must be understood as constituting a part of the cost of service. If the company owes debts, the interest paid upon these should be included; if it has made dividends to its stockholders, the amount should be included also. Indeed, it is generally conceded that the cost of service should rightfully and equitably be made to include a fair return in interest or dividends on the cost of the railroad investment; though as to what return is fair and reasonable, differences in opinion are held and expressed. But for our present purposes it is sufficient to leave any such differences out of view, and to speak in general terms of the cost principle as that which would measure the railroad charges by the cost of service, and which would make the cost of service embrace the actual outlay of the railroad company as above explained, and a fair return in interest or dividends on the cost of the road and its equipment.

To show that the cost principle would be to the advantage of New York, it became necessary to show that the cost of transporting freight between New York and Chicago was, or ought to be, less than the cost between Philadelphia and Chicago, or Baltimore and Chicago, or at least that it was not greater. But upon this point, unfortunately, the information that was produced before us did not appear to be very precise or very accurate. The expressions of opinion were, indeed, clear and strong, but they were generally supported by argument and inference rather than by evidence. Our attention was not directed to official reports or figures, where or by which the actual cost was set forth, but rather to the topographical features of the country between New York and the head of Lake Michigan, which, it was said, offered admirable facilities for the construction of railroads, which would be economical in original outlay, and economical also in their operation. No such economical road, it was said, had been or could be constructed further to the south, and the unfavorable gradients and curvatures on the Pennsylvania and the Baltimore & Ohio roads more than deprive them of all the advantages which they possess in shorter distance. It was also urged that another important circumstance should be taken into the account when the cost is being estimated. By far the larger portion of all the freight carried by the trunk lines is east-

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* DISTANCES VIA THE SHORTEST RAIL ROUTES TO

	Boston.	New York.	Phila.	Baltimore.
Chicago	1,000	900	821	802
Burlington, Ia.	1,216	1,106	1,030	995
Cincinnati	927	743	667	576
Columbus, O	807	623	547	512
Cleveland	671	580	504	483
Detroit	724	673	662	661
Indianapolis	951	810	735	700
Kansas City	1,487	1,324	1,218	1,192
Louisville	1,161	870	794	706
Memphis	1,438	1,247	1,171	1,083
Milwaukee	966	947	908	887
Omaha	1,503	1,393	1,317	1,294
St. Louis	1,212	1,050	973	917
St. Paul	1,418	1,308	1,232	1,211
St. Joseph	1,478	1,356	1,280	1,223
Toledo	784	693	617	596

Taking Boston as the standard, New York averages 12 per cent. nearer to these towns, Philadelphia 18 and Baltimore 22 per cent. nearer.

Between New York and Chicago the line of the Pennsylvania Railroad is 47 miles shorter than that by the Erie and its connections, 50 miles shorter than that by the New York Central and its connections, and 114 miles shorter than that by the Baltimore & Ohio and its connections.

ward bound. When cost is considered, the probability of return freights must be taken into the account, since to whatever extent the cars which convey freight to the seaboard must be returned without loading, the cost of the return must be reckoned as part of the cost of transporting the east-bound freight. And it was confidently asserted that the probability of obtaining remunerative return freights was much greater at New York than elsewhere on the Atlantic coast.

To make out the case of more favorable lines and gradients between Chicago and New York, the route is required, after it leaves the shore of Lake Erie, to follow substantially the course of the Erie Canal to the Hudson, and thence down that river. By that route a road has been constructed with few unfavorable grades and curves, and this road no doubt is or can be operated with much greater economy than would be possible if its line were through a mountainous region. But if we take this as the route for the freight transportation between New York and the interior, and compare it with the routes to Philadelphia and Baltimore over the roads which carry most freights to those cities respectively, we commit the mistake of directing our attention exclusively to the one road which possesses this favorable line, and ignoring altogether the fact that New York has other roads which it is desirable for its interest should live and prosper, and that over each of them the active and energetic merchants and manufacturers of that city are seeking the business of the interior and inviting its custom. Every one of those roads brings to New York a large amount of trade which would not be obtained without its facilities; and it seems certain that New York cannot afford to ignore any one road, any more when it is settling its grievances with rivals than when estimating advantages over them. If, therefore, it be demonstrated that the New York Central and its connecting roads can transport western products from the interior to New York as cheaply as the more southern roads can move them to Baltimore or Philadelphia, it may not follow that the interest of New York would be subserved by the adoption of the cost principle and the bringing of the charges on freight transportation to and from Yew York to the test of what the Central could afford. Prudence would require that at least the probable consequences should be considered: and if among these consequences should be the possibility of some other line to New York being found unable to endure the test of the cost principle, this of itself ought to raise some doubt whether the city of New York could be interested in establishing it. Now the very claim that is made in behalf of the New York Central route, as one of remarkable economy, assumes that the Pennsylvania route is less economical; and the assertion that the Central can carry from Chicago to New York as cheaply as the Pennsylvania can carry from Chicago to Philadelphia, contains within it—since the less is contained in the greater—that the Central can carry from Chicago to New York cheaper than the Pennsylvania, which only reaches New York by carrying past Philadelphia, can possible do. The application of the cost principle, if made under such circumstances, must force the Pennsylvania to this alternative: that it must carry at rates which will not give to the company a fair return in profits, or it most give up competition for New York business; and the Erie, whose line is also assumed to be less favorable than that of the Central, might be compelled to face the same alternative. It probably would not be contended that either the Grand Trunk or the Baltimore & Ohio, whose lines to New York, through connecting roads, are so much longer than those of the Pennsylvania, could compete at all for New York business under a strict application of the cost principle. The natural tendency of its application would, therefore, be in the direction of throwing upon one of the existing lines to New York the bulk of the New York business, to the destruction of the others, and to the final destruction of competition. It is not to be assumed that this is what New York desires. Every great city finds it conducive to its prosperity to secure as many of these avenues of trade and travel as possible; and it is certainly not more important to gain a new line than to preserve one already in existence, and already equipped with all those powers of usefulness which a new project can only promise at some time in the future. If, therefore, the cost of principle were to be adopted for regulating the charges as between the competing cities, it would seem that New York ought to bring into the calculation not one road only, and that the one most economical in construction and operation, but all the roads which contribute to its prosperity, and which it desires to retain.

At Philadelphia and Baltimore it is asserted with great confidence that over no one of the New York roads can freights be conveyed as cheaply from Chicago to New York as they can be over the Pennsylvania and the Baltimore & Ohio roads to Philadelphia and Baltimore respectively. For this confidence certain facts are stated which are supposed to be sufficient to produce the result, and official reports are cited as evidence that the result has followed. The favorable lines of the New York Central, and its affiliating roads, are admitted; but it is contended that all the advantage of these is more than neutralized by greater distance and the greater cost of fuel to the New York roads over those to the south of them. The Pennsylvania and the Baltimore & Ohio roads find the coal, which represents the motive power, in beds at various points on their lines, and can take it up for use at little more that the cost of handling; while the New York roads, on the other hand, and specially the Central, must transport the coal for a long distance at a cost two or three times as great. This cost constitutes a very considerable part of the total expense of moving freight, and it cannot be overlooked or treated as of little moment.

The official figures to which attention was called to show the greater cost on the New York line are to be found in the reports of the New York Central, the Erie and the Pennsylvania, made by the directors to the stockholders, to show the operation of the roads for the years 1880 and 1881. In those reports estimates are made of the cost to the companies respectively of moving one ton of freight for one mile of distance, omitting from the calculation the items of interest and profits. The reports, as will be seen on referring to the note in the margin, make a very unfavorable showing;* and if the figures told the whole story, and if we could be assured that they were made by each company on the same basis, they would go very far toward justifying the other cities in the claims they make. But unfortunately, these reports are, for our purpose, of little value. They cover too much in some respects, and too little in others, to give us the information we need. 1. The trunk-line companies report the cost over their own roads only, and do not include the cost over the feeder roads; but what we need to know is the cost of transportation over the whole line from western points to the seaboard. 2. The companies in their reports do not discriminate between the cost of transporting local freight and through freight, but endeavor only to give the average cost of moving both. But here the reports embrace too much for our purposes, for on this inquiry we are interested only in the cost of moving through freight. If the freights over all the roads were similar in kind, and if the proportion of through freight to way freight were nearly the same on all, the report of average cost might be accepted as indicating the proportionate cost to each road of its through freights. But we must take notice of the fact, which is matter of common knowledge, that the character of local freight is exceedingly diverse on the different roads, and that the cost of handling is far from being uniform. If one company, for example, handles coal in large quantities as way freight, loading a train completely at on-station, and moving it to another for complete unloading, the cost of such business would furnish very unsafe and unreliable means of comparison with that of the local freight of miscellaneous articles, which another road might pick up in small quantities at many way stations, and deliver at as many more. But these railroad companies, unfortunately, have as yet agreed upon no uniform method of keeping accounts, whereby they may determine, by the same standards, the actual outlay of the roads in moving their freights. It would seem that there ought to be no differences in this particular; but the official reports sometimes disclose on examination that the diversities are very considerable, and are not infrequently met with in the accounts of the same company. One company, for example, when it is able to make such betterments as station houses, warehouses and side tracks from its current receipts without increasing its indebtedness, may charge the cost to operating expenses, while another under similar circumstances would charge them to construction account, and still another would include them in operating expenses for time being, and at the end of several years perhaps transfer them to construction account for the purposes of a new issue of stock. Evidences of these different methods of procedure appeared in reports of different companies, which were made use of for their information, or for the purposes of illustration before us. It is no doubt undesirable that there should be this diversity in practice; but while it exists it is necessary to take notice of it. If concert of action among railroad managers could bring about a uniform system of accounts, so that the official reports based upon them, which are made periodically for the information of shareholders, might give valuable and reliable information and means of accurate comparison to the public as well, the change in methods would be likely to prevent many misconstructions of corporate action which now arise in the public mind, and which lead to both public and corporate annoyances.

For all the reasons assigned, we are without reliable information by which to apply the cost principle in the regulation of charges of transportation between the Atlantic cities and the interior, and we cannot say that the application would be to the advantage of New York. *Prima facie* the case seems to be against New York, especially when the Pennsylvania Railroad, which constitutes one of its most important lines, is taken into the account. It is very manifest that that railroad can leave freights at Philadelphia more cheaply than it can transport them the additional 87 miles to New York, and probably it can deliver them for still less at Baltimore, since the unfavorable grades of the road, to which much importance was attached in the New York arguments, are all passed before Harrisburg is reached, and from that point the line made use of by the Pennsylvania to reach Baltimore is shorter than the line to Philadelphia.

The favorable influence which the concentration of foreign commerce at New York ought to have upon railroad rates between that city and the interior, may perhaps be something, for freight tariffs ought to be, and will be, arranged with regard to the probability of compensating freights in both directions. When a railroad company can have freights in one direction only, and must return its cars empty, it must necessarily make the freights pay for the cost of the return. In the eastern and western transportation we have an illustration of this state of things. It is a matter of familiar knowledge that much the largest proportion of freight is eastward-bound, and that large numbers of unloaded cars are constantly being sent west over all the roads. If the course of trade were such, that any one of the Atlantic cities sent out by rail as much freight as it received, its advantage over the others would be obviously very great. Railroad companies could afford to make much better rates upon all freights bound to the city from which they were certain of compensating return loads. It is proper, therefore, that railroad companies should take into consideration the condition of things in this regard, and every participant in foreign commerce has a right to expect that this will be done. We have therefore directed our own attention to the differences in the freights received and those sent out by the four leading Atlantic seaboard cities over the four American trunk lines, and have given in a marginal note the aggregates for the year 1880, which will be sufficient for the purposes of approximate comparison.* The table shows that the proportion of freight sent out from New York over these roads, when compared with that which is received from them, is considerably greater than the proportion at either Baltimore or Philadelphia, but it is nevertheless only as one to four and a quarter, and it is manifest that not only must a large proportion of all the cars which go loaded to New York return without loads, but that a much more considerable number must so return from New York than from either of the other cities.

While, therefore, New York has an advantage over its rivals, in the larger proportion of west-bound to east-bound freight, the advantage, if estimated by the bulk, is not very great. And it must be borne in mind that these four cities do not by any means furnish to the roads all their west-bound freight, but that they take large quantities from other towns along their line. It may be that New York west-bound freights average highest in the freight tariffs, but even then the relative advantage of New York will probably be less considerable than some of its advocates have supposed. And on careful examination of all the arguments advanced at New York, we are not satisfied that a strict application of the cost principle, if it should be found susceptible of application, would be likely to benefit the trade of that city in its rivalry with the other Atlantic cities.

But if the exact cost of transporting freight by rail were attainable, could it be made the standard whereby to measure the charges as between competing cities? We do not consider now what might be just and right as between a railroad company and its patrons if the case of any railroad company could be taken up and considered by itself apart from all others, but of what is practicable in view of existing facts. If the cost principle could be applied, we do not see how the railroad companies of the country could justly complain of it. If they could all receive for the

Continued on page 274.

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* Cost of moving freight per ton for one mile at distance:

	1880. Mills.	1881. Mills.
On the New York Central	5.41	5.02
On the Erie	5.34	5.29
On the Pennsylvania	4.74	4.37

No corresponding figures are given in the reports of the Baltimore & Ohio R. R. Co.

* Freight tonnage by the four American trunk line roads for the year 1880.

	Received.	Sent.
New York	4,266,830	1,022,612
Boston	913,867	309,232
Philadelphia	1,553,381	269,474
Baltimore	1,550,251	241,090

As the business with the Grand Trunk of Canada is not covered by this statement, it will be readily understood that the statement is not so favorable to Boston as it should be, as its business with the Grand Trunk is very large.

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AND
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GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

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EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS

COLORADO MEETING.

Programme.

Saturday, Aug. 19—In Denver. A brief preliminary evening meeting, at which the Institute will be received by the citizens of Denver.

Monday, Aug. 21—Visit to Black Hawk and Central, with an evening session at Central City.

Tuesday, Aug. 22—Georgetown. Idaho Springs. Return to Denver in the evening.

Wednesday, Aug. 23—Leadville, going over the South Park Railroad. Evening session.

Thursday, Aug. 24—Excursions to the Leadville mines.

Friday, Aug. 25—Excursions to the Leadville smelting works, reaching Pueblo at night.

Saturday, Aug. 26—Pueblo Iron and Steel Works, and Mather & Geist's Smelting Works. Colorado Springs and Manitou in the evening.

Sunday, Aug. 27—Colorado Springs and Manitou.

Monday, Aug. 28—Return to Denver. Evening reception.

Tuesday, Aug. 29—Argo Smelting Works. Golden and its smelting works. Subscription dinner.

Besides these excursions, facilities will be afforded those who desire to see the iron and coal mines of Colorado. And for those who can extend their visit, an excursion to the San Juan district will be organized.

Arrangements are being made with the railroad companies for reduced rates to members of the Institute and ladies accompanying them. When concluded, a circular will be issued informing members of the expenses from different points to Denver and return. These rates will probably not exceed two-thirds the regular rates, or about $60, plus Pullman car special rates, from New York to Denver and return. Special facilities are courteously offered by the roads in Colorado for the excursions of the Institute.

Persons proposed for membership have the same privileges as members with regard to the meeting and excursions.

As usual at the meetings of the Institute, ladies are expected to be present. Seventy-seven members with forty-three ladies have already signified their intention of being present at the Colorado Meeting, and it is expected that the attendance will greatly exceed these numbers.

The unusual attractions offered by the mining regions of Colorado are increased at this time by those of the Denver Exposition of mining appliances, minerals, etc., and by the unusual facilities offered for examining mines and works, and acquiring information concerning them.

The representatives of several foreign kindred societies are expected to be present.

Members who purpose attending this most interesting meeting should at once write the secretary of the Institute, who has to notify the railroad companies of the number of tickets required, and the names of those entitled to the special rates offered. They are also requested to inform the secretary promptly of their intention to read papers at the meeting.

Prof. W. I. Marshall, who is well known by his lectures on the wonders of the Geyser Country, offers to conduct a party of not less than eight, nor more than twenty-five, through the Yellowstone National Park. This trip would occupy from twenty-six to twenty-nine days from Denver to and through the Park and back to Denver. The greater part of this time would be spent "camping out" in the Park. The expenses of this round trip are estimated at from $275 to $300 for each person. Full information concerning this trip may be obtained from Prof. W. I. Marshall, Fitchburg, Mass.

R. P. ROTHWELL, President,
27 Park Place, New York City.
T. M. DROWN, Secretary,
Easton, Penn

THE SAINT GOTHARD.

While *fêtes* on the one hand and a dispute at the very banquet table between Swiss, Italians and Germans on the other, combined to render the opening of the Gothard Tunnel an event from even a social point of view, it is now seen that this work has presented extraordinary engineering difficulties. These have been overcome, but the practical working of such an immense tunnel has not yet been sufficiently long in progress. The principal contractor, Favre, is dead, but his estate has lost seven million francs. Almost all the engineers worked for very small remuneration, and are now depending on the sense of justice of the German and Italian Governments.

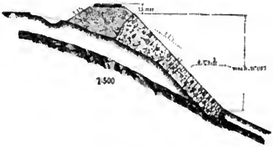


FIG. 1.

The principal tunnel is 14,944 metres in length, but it is preceded and followed by fifty-three other tunnels, which bring up the distance perforated to 40,718 metres, or fully twenty-five English miles.

The situation of the St. Gothard, in the very basis of the Rhine, Rhone, Reusse, &c., with the Lake of Lucerne on one side and the beautiful Italian lakes on the other, has naturally given a very diversified geological character to the mountain and surrounding country. Gneiss, especially, was met in immense masses and of various kinds, as hornblend, &c. Micaceous schist and lime formed in many places the mountain slopes.

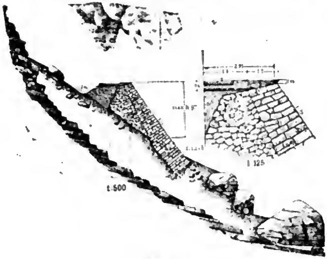


FIG. 2.

The grades were, of course, a matter of great difficulty, but 27, 26 and 25 per cent were adopted on the mountain road and 10 per cent in the valleys. The maximum curve radius was 300 metres, but the stations are always so arranged that trains can enter on straight tracks. The line is also, where necessary, arranged for a double track, but not so in the valleys.

To guard against avalanches, rolling masses of rock and mountain torrents, provided other problems for the engineers. Galleries, bridges and dams have been built, but much yet remains to be done. The normal width of way is 4 metres in the valley and 4·20 metres on the mountain road. The walls of rock cuttings were made vertical when possible, but otherwise given a suitable inclination. In rolling ground the proportion of 1:1·25 was often used, in strongly fixed moraines 1:1.

Strong mason-work had to be extensively used and in various slopes. When the condition of ground and space did not permit the laying of 1¼ ft. talus, and that good stone was plenty in vicinity, then 1 ft. dams, wholly or partly in stone, were built. These stone works are very frequent, and have been built to a hight of 20 metres without any mischance. (Fig. 1.) Even dry walls have been constructed to the hight of 10 metres, with a sloping proportion of 1:⅝, but then the stone material was very fine and the work carefully executed. The arrangement of these works is seen in Fig. 2. As a rule the supporting walls should have had an inclination of ¼, but it was found more advantageous in many cases to make them vertical, and more such have been built on the Gothard lines than is usual.

In general all the viaducts and bridges were built of mason work, but in some cases a small viaduct was judged preferable. Fig. 3 shows the system adopted for such cuts where they had to be carried out under too great a cost. Iron had, however, to be used where the spans were long.

Coming now to the mechanical execution of the work, we find that the Belgian system of perforation was adopted from the beginning—April 4, 1873. The rubbish was removed by two systems, but at Goeschenen and at 5000 metres from the Airolo and the floor of the small gallery was placed on a level with the platform for removing the rubbish.

A great deal of trouble was experienced in the mechanical perforation of the headings, as the vault had to be made, owing to the nature of the ground, before sinking the heading. As soon as the heading was open the left abutment was made by supporting the vault on corner arches which allowed the transport of the upper to the lower part and to begin to attack the banks. This was always done by hand. The greatest care was given to the tracks for the wagons, of which 350 loaded were sent out every twenty-four hours.

Dynamite was used in preference to any other explosive at the beginning, but explosive gum was used latterly. Explosions from thawing the dynamite were altogether avoided by having the cartridge in zinc boxes and these latter placed in zinc-lined boxes. Warm water being put between them, the dynamite was warmed in a regular bain-marie. In the preparing shed the temperature was kept up to the required degree by steam vapor, &c. The floor was carefully strewn with fresh sawdust every day. The light was sent in from outside.

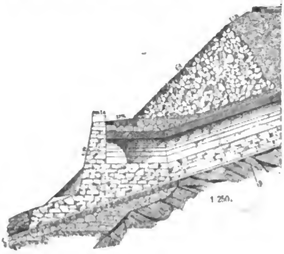
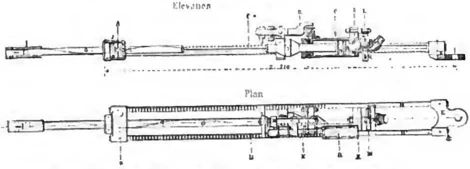


FIG. 3.

Of all the borers used that of Mac-Kean, improved by Seguin, was found most efficacious. The run is longer, and there is no escape of compressed air. The percussion motion is determined by the play of a cylindrical valve acting on piston, the valve turning on its own axis. The general system of distribution is favorable to great rapidity. The rotary movement of the punch is owing to a helicoidal groove in the tool-holder, into which catches the collar of a toothed washer placed in the head. This washer rests against another. In the forward movement of the piston the first washer is brought forward with the tool-holder, and turns on itself, while the tool strikes without rotating. In the backward movement, on the other hand, the first washer or disk gears into the other washer, thus fixing it steady and forcing the punch to rotate, and as it is the withdraw movement there is no resistance. According as the hole deepens the piston advances in the cylinder, and would strike the bottom if the latter remained immovable, but the cylinder is made free by a device, and the air is brought in front. The backward movement is produced by raising a lever with an eccentric, and thus lowering the piston; as the cylinder is not behind it retreats at every stroke of the piston, as it used to advance when fixed in front. (Fig. 4.)

FIG. 4.—SECTION THROUGH V X.



MACKEAN-SEQUIN BORER.—STROKE OF CYLINDER ON LONGITUDINAL SLEEPERS.

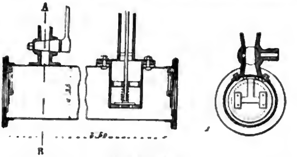


FIG. 5.—PUMP.

One of the greatest difficulties met with was the enormous quantity of water which broke into the tunnel from the Airolo side. The whole southern slope of the mountain was full of springs. The very borers were stopped, and the dynamite forced out before it could be used, so strong and universal were the springs. In July, 1875, the quantity of water coming from the tunnel was 348 litres per second. M. Favre thought he would use compressed air for working a pump. (Fig. 5.) There is a valve at each end. A cock with three conduits acts as feeder or exhaust for the compressed air, while a tube of smaller diameter, having a stop valve, allows the escape of the water. Metallic wires prevent any foreign substance from entering the pump. When put in a mass of water the valves open, the tube is filled, and when the air-cock is opened the water is expelled.

The temperature formed the most dangerous of all the obstacles, and it would seem that the very limit of human endurance was reached in the St. Gothard.

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A COMMON PRIME MERIDIAN.—The Senate has passed the resolution of which the following is the text, and it seems that the serious embarrassment now felt in the affairs of commerce, through the absence of an accepted standard for the computation of time, will be relieved:

> "*Be it Resolved, etc.*, That the President of the United States be authorized and requested to extend to the governments of all nations in diplomatic relations with our own an invitation to appoint delegates to meet delegates from the United States in the city of Washington, at such time as he may see fit to designate, for the purpose of fixing upon a meridian proper to be employed as a common zero of longitude and standard of time reckoning throughout the globe; and that the President be authorized to appoint delegates, not exceeding three in number, to represent the United States in such international conference."

THE River and Harbor Appropriation bill, as passed by both Houses of Congress, appropriated $18,743,875. On the first instant the President sent a message to the House of Representatives refusing to sign the bill and stating his reasons. The principal objection was "that it contains appropriations for purposes not for the common defense or general welfare, and which do not promote commerce among the States. These provisions, on the contrary, are entirely for the benefit of the particular localities in which it is proposed to make the improvements." On the second instant the bill was passed over the veto, and the amount above-mentioned will be expended on the items composing the bill.

CORRECTION.—In our article "Cheap Motive Power," published last week, in the formula, $K = 3$. should be $K = .3$; "Hirm Bros.," should be "Hirn Bros."

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PERSONAL.

MR. J. E. SICKELS is Chief Engineer of the Evansville, Dayton & Eastern Railroad. The road will be constructed at an early day.

CARLOS MORENO has been appointed by the Mexican Government Inspecting Engineer of the Topolovampa road.

EDMUND HARDING has been appointed Chief Engineer of the Toledo, Cincinnati & St. Louis (N. G.) Railroad.

MR. JAMES R. DE REMEO has resigned the position of Assistant Engineer on the Denver & Rio Grande (N. G.) Railroad.

THE AMERICAN INSTITUTE OF MINING ENGINEERS.

The railroad fares to Denver and return from New York City, for the meeting of the society in August, is $113, which includes sleeping cars, both ways. Saving over ordinary fare, $26. The minimum cost of the entire trip will hardly be less than $250, which will probably prove a good investment for all who decide to go.

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IN MEMORY OF ALEXANDER LYMAN HOLLEY.

New York, June 14, 1882.

Dear Sir: After the death of Mr. Alexander Lyman Holley, the American Society of Civil Engineers, the American Institute of Mining Engineers, and the American Institute of Mechanical Engineers, in each of which he was a leading member, appointed special committees to devise and execute suitable measures in honor of his memory. These committees have united for common action as a joint committee, and this joint committee has appointed the undersigned a subcommittee, with authority to issue the present circular.

Both the character and the career of Mr. Holley marked him as a true representative of the highest type of American engineers. Without undervaluing the great advantages of foreign travel and culture, we deem it a significant circumstance that our departed colleague was educated in American schools, and bred in American practice. When he began the journeys abroad from which so many important results were to flow, it was with a thorough knowledge of the condition and needs, in his native land, of the arts with which he was connected; and the astonishingly numerous and varied lines of inquiry which he pursued had one element in common—the dominant purpose of his life—to gather for the benefit of this country the best fruits of skill and experience abroad. Our railway practice, our ordnance system, our steel manufacture, and many incidental points in our mechanical engineering, were successively illuminated by his skillful analysis and criticism, and enriched with the treasures he had wisely selected from foreign sources, as well as the fruits of his own inventive genius.

As an active and enthusiastic laborer for the elevation of the profession through the harmonious co-operation of its members in this country, and as an inspiring instructor and sympathetic friend of young American engineers, his influence was scarcely less important. The unanimity and extent of the expression of sorrow at his death might be called national, had they not been augmented by so many voices from beyond sea.

Finally, his personal virtues and attractions were such that his countrymen may well delight to honor him. No atom of envy or detraction alloys the praise which all are eager to bestow upon him. Alike in private and in public life, he was beloved as much as he was admired.

It was natural that from many quarters the suggestion should come of a memorial more permanent than words to a life so worthy in itself and so fruitful of blessing to a nation. In obedience to this suggestion, and after due consultation, the following plan has been adopted:

It is proposed to erect in the Central Park of this city a monument to Alexander Lyman Holley, consisting of a suitable pedestal in stone, with architectural and symbolic decoration, surmounted by a portrait-bust in bronze. The cost of the whole, executed by the best obtainable skill and after designs to be approved by the joint committee, will be about $10,000. Before further steps are taken, it is desirable to ascertain by actual subscriptions the amount of money which may be relied upon; and for this purpose the present circular is issued.

In order that the opportunity of taking part in this testimonial may be extended to as great a number as possible, subscriptions will be received from all who desire to contribute. No limit has been fixed, as it is desired that each subscriber give according to his ability, and that the list be large. Names and money may be sent to Charles Macdonald, Treasurer, 52 Wall street, New York City, and will be periodically acknowledged in the *Iron Age*, the *Engineering and Mining Journal*, and the *American Machinist*. The subscription is not confined to any class or profession, but is cordially opened to all who sympathize with its object.

Chas. Macdonald,
R. W. Raymond, } Sub-Committee.
J. C. Bayles,

[We publish the above circular, because we feel that a great many civil engineers, who otherwise might not receive it, will feel it a privilege to contribute something to the memory of Alexander Lyman Holly. It is not necessary that we add anything that we could say to the above circular. —Ed. Eng. News.]

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page 263.*)

CCCLXVIII.—FREDERICK CITY.

Frederick City, Maryland, is on level ground in a basin 280 ft. above sea level, in a valley inclosed by the Catoctin Mountain on the northwest and the Linganore hills on the east. Carroll Run, a small stream, flows through the centre of the city.

Settled more than a hundred years ago, it was incorporated as a city in 1805.

Water works were built at a date which it has not been possible to ascertain, by a private company, taking the supply from Saw-mill branch of Carroll Run, and from springs on the Mount Philip farm.

These works were abandoned some years ago, and a supply was introduced by the city from nine springs in the Catoctin Mountain and two artesian wells, from which the water is conveyed by covered drains to a receiving house, and thence by 4½ miles of 6-in. cast-iron pipe, with a fall of 136 ft., to a reservoir built on excavation and embankment, 125 ft. square and 17 ft. deep, and lined with brick. It contains 1,900,000 gallons, is a mile northwest of the city and 75 ft. above it. In 1880 an additional supply was procured from the Great Tuscarora, a mountain stream 6½ miles from the reservoir, to which the water is conveyed through an 8-in. cast-iron pipe with a fall of 273 ft.

Two lines of 10-in. pipe conduct the water from the reservoir to the city. Distribution is by cast-iron pipe of the sizes and lengths of which no data are obtainable. Neither is the number of fire hydrants and of taps known.

The population in 1880 was 8,486. The daily consumption in 1881 was 403,200 gallons.

The cost of the works cannot be ascertained. The bonded debt is $70,000 at 5 per cent. interest. No further financial statistics are given. George Ebert is the Superintendent.

CCCLXXIX.—SOMERVILLE, N. J.

Somerville, New Jersey, in lat. 40° 35' N., long. W., is on undulating ground on the Raritan River. It was settled about 1800.

Water works were built by a private company in 1881-2, after the plans of George H. Pierson, C. E., taking the supply from the Raritan River, which flows through a red shale district and is much discolored except in very dry weather. The water used is filtered by four multifold filters of the Newark Filtering Company's type, each 5 ft. in diameter and 8 ft. high, which are stated to have a daily capacity of 1,500,000 gallons. It is then pumped by a Worthington duplex pump, of 12-in. bore and 8½-in. stroke, driven by a 44-in. Leffel turbine wheel under 14 ft. head. There is also a steam pump of the same dimensions. The water is pumped into a stand-pipe of 10 ft. diameter and 150 ft. high.

Distribution is by 6½ miles of cast-iron pipe of from 12 to 3-in. diameter, with 42 fire hydrants, 25 gates and 180 taps. The town pays $28 per year for each fire hydrant. Service pipes are of lead.

The population in 1880 was 4,620, and in 1882, 5,160. The daily consumption is 200,000 gallons. The works have cost $50,000.

A. V. D. Honeyman is the Secretary, and J. Harper Smith the Superintendent.

CCCLXXX.—SPRINGFIELD, O.

Springfield, Ohio, in lat. 39° 53' W., long. 84° W., is on gently undulating ground on Lagonda Creek. Settled in 1804, it was incorporated as a village in 1827, and as a city in 18—

Water-works were built by the city in 1881-2 after plans of J. D. Cook, C. E., taking the supply from a filtering gallery along the bank of Buck Creek. Two wells, 100 ft. apart, are connected 20 ft. below the surface by a dry stone culvert 3 ft. in diameter.

A Cope & Maxwell steam pumping engine lifts the water 200 ft. into a stand pipe 30 ft. in diameter and 110 ft. high. This gives a head of 220 ft. at the centre of the city.

Distribution is by 30 miles of cast iron pipe of from 24 to 6-in. diameter, with 250 fire hydrants, 260 gates and 250 taps.

Service pipes are of lead and of galvanized iron.

The population in 1880 was 20,729.

The works have cost $380,000, which is the amount of the bonded debt.

The works have just gone into operation. They are controlled by the trustees elected by popular vote.

Edward Gwynn is the Superintendent.

(TO BE CONTINUED.)

Corrections.—July 29, 1882, p. 263, *Waco*, third paragraph, for "the pressure," read "fire pressure." Page 263 in seventh line, first column, read, "Expenses, including interest, $2,300."

Acknowledgments.—The receipt of statistics, as follows, is acknowledged with thanks: From George H. Pierson, C. E., statistics of the water-works of Somerville, N. J. From H. L. Schlater, superintendent, report of the water-works of Meriden, Conn., for 1881. From H. G. Holden, superintendent, report of the water-works of Lowell, Mass., for 1881. From J. D. Moler, city engineer, statistics of the water-works of Springfield, Ohio.

CORRESPONDENCE.

PRACTICAL NOTES ON HYDROGRAPHIC SURVEYING FOR ENGINEERING PURPOSES—CORRECTION.

Portland, Me., July 31, 1882.

Editor Engineering News:

I inclose a few *corrections*. July 29, 1882, page 257, near head of first column, for "beach marks" read "bench marks."

Middle of second column, for "diligently" read "deliberately."

Page 258, bottom of first column, for "announced" read "amended." Near bottom of second column, for "carry the telemetric" read "carry the telemeter." Near middle of third column, for "pair of ranges," read "set of ranges."

Yours truly, A. C. Both, C. E.

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TWO WESTERN TOWNS.

The two smart towns of Fargo and Morehead look at each other across the muddy Red River ditch with jealous eyes. They will not bridge the stream, because each is afraid the other would profit by a convenient crossing. Vehicles ferry over on a rude flat-boat, worked by hand-power applied to a rope stretched from bank to bank, and pedestrians are beholden to the railroad company for the use of its bridge. Morehead, the Minnesota town, has three thousand inhabitants; Fargo, the Dakota town, boasts of six thousand, and styles itself the Red River metropolis. Both welter in a sea of black mud in the season of the thaws and rains; both are largely devoted to speculation in lots and land, and both are equally unattractive to the eye. They are in reality a single town, commercially speaking, and a remarkably prosperous one, too. The railroad system has made them the business center and distributing-point for the entire Red River Valley, and out of their present jumble of muddy streets, cheap-pine cottages and shanties, and vacant lots, saloons, stores, and lumber-piles, will grow up a handsome city of fifty thousand inhabitants within the present generation. Already there is a handsome hotel, rejoicing in the architectural oddities of the Queen Anne craze, a street railway, an electric light company, water-works, half a dozen banks, a daily newspaper, a number of creditable churches and school buildings, and a few pretty dwellings. Real estate speculation runs wild. Visions of a second change have turned the heads of the inhabitants. The talk is all about lots and values—how much this or that corner is worth, what Jones paid for his strip of mud, or what Smith holds his at. The real estate agents have their offices in the hotels, in order to watch the arrival of guests and seize upon the supposed capitalists seeking investments, or the immigrant looking for a farm. No well dressed stranger need wait long for the offer of a free ride about the future city and a valuable guide to explain the many choice openings waiting for him and his money.—"*The New Northwest, by E. V. Smalley, in the Midsummer Holiday Century.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Brooklyn (N. Y.) Supply of Water.—Arrangements have been made to put in operation the reserve pumping engine at Springfield Brook. It has a capacity of 2,000,000 gallons.

Illinois Artesian Wells.—The artesian well now being sunk at the new city hall in Ottawa has reached a depth of 275 feet. They are now in sand-rock and have a good flow of water, and are averaging about 10 ft. per day. They have about 25 ft. further to bore before clearing the sandstone.

New Engine.—The new engine for the Phœnixville (Pa.) water-works will be ready in November. It will have capacity to throw 1,500,000 gallons a day.

Water Works Wanted.—A despatch from Wabash, Ind., says:

The water-works question is again being agitated in this city. The project of obtaining a supply of water from the big well north of the city has been abandoned, as the flow was entirely too small. The City Council is now considering a scheme for pumping water from the Wabash River, and it is very likely that an election to determine whether the people want water works will be held within the next thirty days.

Yorkville (Canada) Water Supply.—The question of getting a sufficient supply of water is now being agitated in the above village. The present water-works were built four or five years ago, and the water is drawn from a reservoir situate northwest of Mr. McMaster's property, fed principally by springs, but the supply thus obtained is quite insufficient for summer consumption. Last year this want was first noticed, and again this year. There are two plans now under consideration; the first is to obtain an additional supply of water from Parkdale village, for which proper preparations were made when the reservoir at Parkdale was constructed, as there is an opening where a second pipe can be attached, and room for a second set of engines. The contractor to whom the matter has been submitted offers to lay a 10 inch pipe from Parkdale to Yorkville for $40,000, and it is estimated that the cost of the extra engines would not exceed $50,000. A proposal has also been made by a syndicate of wealthy capitalists to take up the whole of the Yorkville Water-works, paying for their cost, and guaranteeing the village an ample supply of water. They have it in view to run pipes to Bond's Lake, eighteen miles distant, and if it does not yield a sufficient supply—there are no means of knowing at present—then a pipe would be run to Lake Simcoe at a cost of $250,000. Concerning the question of drainage, it is contended, in opposition to the majority of the Council, that a drain through the University Creek would cost as much as to drain down the ravine into the Rosedale Creeks, whilst it would only be an outlet for a few acres at the west end of the village; so that drainage by the ravine would be preferable, as it would drain the whole village. It is thought that a main drain from the extreme west of the village, laid due east would carry off all drainage, both north and south, independently of Toronto. Mr. A. Harvey, of Rosedale Road, has been appointed by the Yorkville Council to confer with the Parkdale Corporation respecting the supply of water.

ELECTRICITY.

The Telephone in Toronto.—The new telephone system connecting the different stations and call-boxes in various parts of the city with the central depot is working admirably. When the Central Station is signaled a little red indicator drops, showing the depot desiring connection, the principle being the same as used by hotel indicators.

New Electric Companies.—The following companies have filed articles of incorporation at Albany, N. Y.: The Oswego Electric Light & Power Company; capital, $50,000. The Parker Electric Manufacturing Company, of Little Falls; capital, $40,000. The Union View Company, of Rochester; capital, $50,000. The Merchants' District Telegraph & Burglar Alarm Company, of New York.

Paris Electrical Awards.—London, Aug. 2.—Among the awards to exhibitors at the International Electrical Exhibition at the Crystal Palace were the following: A diploma of honor to the Anglo-American Cable Company; a gold medal to Prof. T. A. Edison for lighting apparatus, etc.; a gold medal to the Anglo-American Brush Light Company for the Brush dynamo machine and arc lamp; a gold medal to the White House Mills, of Hoosac, N. Y., for a dynamo machine; a gold medal to the Direct United States Cable Company; a gold medal to Prof. A. E. Dolbear, of Boston, for an electrostatic telephone, and a silver medal to the Philadelphia Dynamic Company. Numerous awards to British exhibitors were made.

Cable Extension in America.—The Central and South American Cable Company, with wires touching at points on the Mexican and Central American coast, crossing the Isthmus of Panama and extending along the western coast of South America to Callao, announce that their lines will be completed and thrown open to public use by the close of the present month. Connection will be made at Galveston with the Western Union Telegraph Company, and at Callao with the Transcontinental and Eastern telegraph systems of South America, so that the two continents of the Western Hemisphere will be in complete communication.

The business of the Western Union Telegraph Company is showing a large increase. The number of messages handled at the main office average 70,000 per day.

RIVERS AND HARBORS.

The Potomac.—The Washington *Republican* says: The appropriation for the past fiscal year for the dredging of the river channel near the city having become exhausted, the dredging machines and scows heretofore at work in front of the wharves have been removed to West Washington by order of the engineer in charge, Major Rainehardt, and commenced operations near Easby's wharf upon the Georgetown channel. The dredgings are carried down upon the mud scows to the flats below Analostan Island instead of being dumped upon the flats below Long Bridge as was done in former years. It is thought that by the time when the appropriation, still available for the present work, is entirely exhausted the new appropriation will permit the resumption of the work in the Washington channel.

The Kankakee River.—Professor Campbell, who has charge of the Kankakee valley, under direction of Governor Porter, is now engaged in that survey for the purpose of digging a new channel for the Kankakee river, by which it is proposed to reclaim from 800,000 to 1,000,000 acres of overflowed lands.

STREETS, DRAINAGE, ETC.

Proposals for Sewer Work.—The City Council of Grand Forks, Dakota, will receive proposals until Aug. 8 for the construction of a sewer on De Mers avenue, from Sixth street to the Red River of the North, a distance of about 1,700 ft., and 18-in. pipe with manholes and catch-basins. Separate bids may be made for the pipe or excavation. Plans and specifications may be seen at the office of the city engineer, and specifications will be sent on application.

Street Improvements in Washington.—Under the recent appropriation act for the District of Columbia, the District Commissioners have prepared proposals for the improvement of several streets in this city, the approximate estimates of which are as follows: Asphalt pavements—New Jersey avenue, from D street north to M street north; Massachusetts avenue, from 1st street north to 3d street west; Rhode Island avenue, from 9th west to 13th west; New Hampshire avenue, from M street north to Dupont circle; Pennsylvania avenue, from Washington circle to 26th street west; 14th street west, from M street north to Boundary; 2d street east, from Pennsylvania avenue to D street south; D street south, from 2d street east to 3d street east; 5th street east, from East Capitol street to Pennsylvania avenue; M street north, from New Hampshire avenue to 26th street west; 33d street west, from N street north to P street north. These streets are to be repaved asphalt, aggregating 81,926 square yards, and the with gutters and railroad track with granite blocks, the gutters aggregating 7,204, and the railroad tracks 1,504 square yards of granite block pavement respectively, the granite blocks will be furnished by the District for all streets west of 7th street, from the property yard at G street northwest, and at the 6th street property yard for all streets east of 7th street west. Asphalt block pavements are to be laid on 15th street west, from Pennsylvania avenue to B street north; 4th street east, from Pennsylvania avenue to East Capitol street; 26th street west, from N street north to P street north, aggregating 14,140 square yards. Granite block pavement is to be laid on F street south, from Half street to 4½ street west. This work embraces the grading, including haul, of 5,450 cubic yards of earth, taking up, rejointing and relaying of 3,220 lineal ft. of 5-in. blue stone, laying of 970 lineal ft. of new 5-in. blue stone curb, taking up and relaying 3,120 lineal ft. of 12-in. gutter flag, taking up and relaying 2,000 lineal ft. 16-in. gutter flag, laying 3,900 square yards new brick sidewalk, taking up and relaying 680 square yards brick sidewalk, building four receiving basins, laying 200 ft. 12 in. sewer pipe, laying 6,280 square yrds granite block pavement, and the taking up and relaying 800 square yards of granite block pavement. The granite blocks, new curb and sewer-pipe will be furnished by the District. North Capitol street, from E to K streets, is to be graded and regulated, embracing 8,500 cubic yards of grading; hauling same; graveling 8,450 square yards; laying 533 lineal ft. 5 by 20-in. blue stone curb; taking up and relaying 2,782 lineal ft. of 5-in. blue stone curb; taking up and relaying 1,730 square yards cobble gutters; laying 3,100 square yards brick sidewalks; taking up and relaying 1,150 square yards brick sidewalks; laying 1,007 lineal ft. 12 in. gutter flag; taking up and relaying 2,597 lineal ft. 12-in. gutter flags; taking up and relaying 1,657 lineal ft. 16-in. crossing flag; setting 36 lineal ft. 6-in. granite circular curb; building four receiving basins; rebuilding three do., and laying 200 lineal ft. of 12-in. sewer-pipe. The District furnishes the curb, sewer-pipe, bricks and all other material necessary for the work.

RAILROADS.

Street Railroad Incorporated.—The Minneapolis & St. Paul Street Railway Company, $1,000,000 capital, has filed articles of incorporation with the Secretary of State. The object of the corporation is to run a motor line between the two cities to connect with Lake Como, and to operate a telegraph and telephone system.

Railroad Statistics.—Who gets the most out of the railways, the bloated capitalists who have the impudence to build them, or the downtrodden people who ride on them and ship by them at astonishingly cheap rates and the vast army of men, women and children whom they support? Let us see. In round numbers in 1881—

The railways earned $725,300,000.

They paid out for working expenses $110,000,000.

The interest on their bonds was $128,000,000.

They paid their stockholders in dividends $93,200,000.

What farmer, out of every $100 which he receives for his crops, pays his laborers $62, the holders of his mortgage $17, puts into other necessary outlays $9, and keeps only $12 for his capital, labor and risk? Not one. —*Railway Age.*

A Narrow-Gauge Road Sold.—St. Louis, July 27. —The West End narrow-gauge road, 17 miles long, was bought to-day by James E. Young, of Chicago, for $87,000. The road will be bonded for $200,000 and extended to Creve Cœur Lake, the St. Louis regatta water, and to St. Charles, on the Meramec River.

Mexican Roads.—A despatch from Matamoras to the St. Louis *Globe-Democrat* gives the following account of the progress being made on the railroads in Mexico: The various railroad enterprises over the Republic are generally progressing favorably. The Central Railroad has reached Celaya on its Southern Division, and on the northern end they are but about thirty miles from Chihuahua. Their side competitor, the San Louis Potosi and Tampico Railroad, at present languishes. They have some twenty-six or twenty-eight miles of road completed to a little place called Buena Vista, and now have a bad stretch of over twenty-five miles, without water, to cross before reaching the mountainous country. Work has about stopped, there being a great lack of laborers, the men leaving on account of the mismanagement of the former superintendent, who, with an abundance of money and material, and over 3,000 workmen, built less than thirty miles of road. The National Railroad, or Palmer & Sullivan folks, are going ahead at all points on their line, and will shortly be running into Monteray. It is the general opinion that they will stop there some little time, as the road beyond, to Saltillo, is over a difficult and rocky country.

Fast Approaching Completion.—Norwalk, Ohio, August 1.—Iron on the Wheeling & Lake Erie is now down into Toledo, and the ballasting nearly finished. The link connecting it at Massillon with its new acquisition the Cleveland & Marietta at Zoar is also completed, and the whole line from Marietta to Massillon, and thence to Huron and Toledo, is open for trains. The announced opening for regular traffic, to occur this week, on account of the scarcity of labor during harvest to complete the ballasting, has been postponed for two weeks. Work on the shops here is progressing with speed. The large brick repair-shop is being roofed to-day, and brick-word on the round-house begun. The foundations of the other structures are practically done. They propose by October to employ one hundred men in these shops.

The Little Falls & Dakota Road.—The amount of track laid in June was six miles, and in July nineteen; total of twenty-five miles. The grading is all completed for 85 miles from present terminus of track and the company expect to get the tract on that the coming month, which will bring it to Glenwood, Pope County, Minn.

Road Sold.—The Indianapolis & St. Louis road has been sold to the Cleveland, Cincinnati & Indianapolis Company for $1,896,000.

Incorporated.—Articles of incorporation have been filed at Albany, N. Y., by the Hornellsville & Conhocton Valley Railroad Company, of Hornellsville. Capital, $160,000.

The Catskill Mountain Railroad, running between Catskill village and the mountains, has been finished.

Canadian Notes.—Grading the line of the Lake St. John Railway brth of Raymond is now proceeding rapidly, 300 men being employed upon it. It is hoped 10 miles more of the line will be opened in November next. A new iron bridge of 250 ft. span, to cost $40,000, has been ordered for crossing the Anne River at St. Raymond. The new stone piers at the extremities of the bridge over the Jacques Cartier River at Conolly's mills are being rapidly completed.

Canadian Notes.—The Portage, Westbourne & Northwestern Railway has been constructed to Westbourne.

Barbed wire fence is being rapidly substituted for the old board fence on the Grand Trunk line between Toronto and Brockville.

There is likely to be considerable contention between London and Brantford as to which city will secure the workshops which will be necessitated by the fusion of the Grand Trunk and Great Western Railways. Mr. Wallis, Mechanical Superintendent of the Grand Trunk, was prospecting west of London this week with a view, it is understood, of making the location.

According to the Lindsay *Post*, it seems that the Midland and Ontario & Quebec railways, from Perth west to Peterboro', are located as closely as possible to each other for some fifty miles of the distance, the centre lines being only 65 ft. apart. About 500 men are now employed on each line, and the work on both is being pushed as speedily as possible.

A new style of excursion car is being introduced by the Midland. They are comfortable, roomy cars, covered and well-seated. An additional convenience is that the passengers can get off and on by the entrance at the sides of the cars, no small consideration when the hasty way in which excursionists clamber on to trains is considered. The cars will enable the road to meet the heavy demand for train service in excursions to Toronto and other points.

Steel rails are to be laid on the Grand Junction between Belleville and Stirling.

The work of surveying and laying the whole line of the Central Railway will be completed within two weeks.

A gang of 150 men, divided into three clearing and six grading gangs, have been set to work on the Ontario & Quebec, at Indian River in Cavan township. Messrs. McDermid & Hendrie, the contractors, intend commencing work near Peterboro' very shortly.

Mr. Wood, the contractor who built the Credit Valley, has been engaged along that road in collecting opinions as to the benefits derived from it, which he intends to bring to bear on those interested in a projected road in the St. Catharine's district.

TUNNELS.

A Chicago Tunnel.—The walls of the La Salle street tunnel, from the main opening to Randolph street, have shown a decided inclination to "bulge in," and the thoroughfare is closed for a season in consequence. There is a fear that it may be necessary to rebuild some sections from the foundation.

CONTRACTS LET.

HOTEL CONTRACTS LET.—The contract for building the new hotel to be put up at Emmetsburg, Ia., by the Scottish-American Land Company, has been let for $19,000.

A NEW MEXICAN CONTRACT LET.—The contract for grading 46 miles of the Silver City, Deming & Pacific Railroad has been let to John Scott. Time limited to 90 days. This is a new company, organized in March to build standard gauge road from Silver City, the center of the great New Mexican mining district, to Deming, the junction of the Atchison, Topeka & Santa Fe and Southern Pacific Railroad. Grading will begin Aug. 1. J. P. Whiting, of Boston, is the president of the company; Major E. G. Shields the chief engineer.

The contract for iron, furring and lathing at the Philadelphia Court-House and Post-Office has been awarded to J. W. Hoyt at $33,700. One of the bids for this work amounted to $121,000.

BUILDING.

A NEW FREIGHT DEPOT.—A Chicago dispatch says: "The officials of the St. Paul Company have decided to tear down the old repair-shops and adjoining buildings south of Fowler and east of Sixth street bridge, and to erect in their stead a large freight depot. The machinery now in use in the shops will be sent to the new Menomonee Valley works and utilized there. The cost of the new freight-house will be $75,000, and work upon it will begin before the end of the summer. The present freight accommodations of the company are entirely inadequate, and this new move of the management is one that is deemed absolutely necessary, owing to the enormously increased freight traffic.

SWARTHMORE COLLEGE.—The total subscriptions for the rebuilding of the college amount to $77,885.

LABOR.

WAGES IN THIS CITY.—Mayor Grace has been informed by the Dock Commissioners that they have decided to increase the wages of the laborers in their department from 20 to 23 cents per hour, and the wages of the dock-builders from 25 to 28 cents per hour. At the request of the workmen they will be employed ten hours per day.

WAGES IN INDIANA.—A note from Montpelier says: The Fort Wayne, Cincinnati & Louisville Railroad Company have at last secured men to lay their new steel rails on the north end, paying them $1.50 per day. Since harvest commenced the section men have been helping to take up the harvest along this line at good wages, leaving the company destitute of section men. However, the increased price per day offered now by the company assures plenty of men, and work has already commenced under the supervision of Roadmaster Wagner.

BRIDGES.

THE BROOKLYN BRIDGE.—On the 2d inst., Mr. Henry C. Murphy, President of the East River Bridge Trustees, sent to the Mayors of both cities the following report of the work done on the bridge during the past week: "The work done on the bridge during the past week has consisted of regulating and bringing to grade the floor beams and bottom chords from Panel No. 14 to Panel No. 20, preparatory to the erection of the trusses to that point, and the erection of a portion of the posts. The six floor beams at the slip-joints in the trusses have been received, and four of them have been put in place. A large amount of work has been done in putting in place scattered members here and there, as they have arrived, consisting of bridging trusses, lower chords, intermediate floor beams, etc., which have been omitted in consequence of not having been delivered regularly and in order. The men in the yards have received, assorted and stored the steel as it has arrived, and sent it aloft, as required, and when not so employed have continued the painting. The paving has been commenced on the Brooklyn approach. On the Franklin square (New York) bridge, the plates for carrying roadway have been riveted. The cast-iron fenders for one roadway have been erected and secured. Four trusses are now completed and the erection of the bridge is about half completed. There has been received during the week from Edge Moor 191 1808-2000 tons of steel, making the receipts of that material during the month ending July 31, 470 1688-2000 tons. The first contract of the Edge Moor Iron Company for steel, amounting to 5,500 tons, has been finished, and 138 293-2000 tons have been received on account of the second contract, which amounts to 1,064 tons, leaving 926 tons in all yet to delivered."

A CORRECTION.—In our last issue we published the following item:

The Central Bridge Co., of Buffalo, N. Y., has the contract for the bridge over the Delaware River at Portland, Pa., for the Pennsylvania, Slatington & New England railroad.

The contract was awarded to C. E. Danforth, 71 Broadway, New York.

A CHICAGO VIADUCT.—Some interesting details concerning the Chicago viaduct over the Chicago, Burlington and Quincy railroad, at Polk street, which has just been completed, have been published. The work was done at the cost of the railway company, but under the supervision of the engineers of the city, who were instructed to see that proper provision was made for the public. The result is a bridge which is pronounced one of the finest in Chicago. It is constructed of iron, in two spans, each measuring 172 feet long. The total length, with the approaches, is 2,074 feet. The width is thirty-eight feet in all, and of that space twenty-two feet is given to roadway and five and a half feet to sidewalk on each side. In the construction of the approaches a rise of one foot in forty is given on Polk street, and one in thirty in the approach on Canal street. The iron work was supplied from a foundry at Buffalo. If a viaduct should be valued by its cost, this one should be held in high estimation, for the railway company has been called upon for $111,115, without taking into consideration the sums it had to pay the owners of land damaged in the execution of the work.

REPORT OF THE ADVISORY COMMISSION UPON DIFFERENTIAL RATES.

Continued from page 269.

transportation service the cost of the service, as above explained, they would benefit their average condition very greatly by accepting it, for they are not now receiving, on an average, anything near the average legal interest of the country on the cost of their investments.[*] Many of the companies—perhaps the majority of them—in order to realize cost, would be compelled to increase their charges very considerably, while others, including perhaps some of these trunk lines, might be called upon for a reduction. The general result would be, not a diminution of charges, but an increase; and it is hardly probable that the country at large would be satisfied with the change, though it might affect particular localities favorably. Moreover, we are to consider that the question of the application of the cost standard to railroad charges arises for discussion and settlement after cities have been built, routes established, canals made and railroads constructed; and that the solution of the question may affect all these beneficially or otherwise to an extent that is beyond present calculation. We have not an unsettled country before us to plan and make laws for, whose people, when they select their homes and places of business, can calculate the result of existing rules and regulations upon the towns they build, or the industries they establish; but the towns already exist, and have been created at immense cost, in view of advantages which were supposed to make them attractive and desirably as location for trade and commerce; and their existing importance as the homes of great numbers of people, and as the centres of vast manufactures and immense exchanges gives them claims upon the country and upon those who have in any degree the material interest of the country in charge, and gives them powers of defence also when assailed in the rivalry of business, which are not to be overlooked or lightly regarded.

The several towns, it is true, came into existence under circumstances which may be different from those which now surround them; and in view of advantages, which in many cases have been rendered comparatively unimportant by subsequent improvements and inventions—as canal and river navigation in many parts of the country has been rendered unimportant by the invention of the locomotive and the iron road—but the towns themselves, their people and their business remain as great and sturdy facts, which neither the country can overlook, nor the government of the country, nor any of its public agencies. The continued existence of these towns is to be assumed, and their welfare is to be calculated for when laws are made, or regulations having the effect of laws are established. It would be as inadmissible and as unjust deliberately to plan and arrange for the gradual destruction of a great city through the slow but certain annihilation of its business, as it would be to bring destruction upon it by fire or pestilence; and we are not to contemplate with complacency an offence of that nature against organized society. While it is not the province of government to build up cities for its people, it is its plain duty to permit the cities the people build to live; and it should so shape its own action as to allow every town, as far as possible and reasonable, to avail itself of all its natural and acquired advantages in addition to the prosperity, happiness and comfort of the local community. This seems too plain and indisputable a proposition to be contested by any official authority or public agency.

In a certain sense railroad companies are public agencies, and in some degree they exercise powers which are *quasi* governmental. They make regulations for their business to which the general public are expected to conform; and these regulations are, in some respects, as important as the police laws established by the state itself. Among these are the regulations respecting charges for railroad service. According as these are heavy or light upon the traffic of a particular locality, its trade is likely to decline or prosper, and so dependent is commerce upon railroads that the growth of a town is likely to bear some proportion to the extent of its railroad facilities, and the liberality with which it is treated by railroad managers.

We should consider then what might be the effect of a strict application of the cost principle as between the competing Atlantic cities, say, for illustration, the cities of Baltimore and New York. Baltimore is now a large and prosperous city; it is the chief business center of a territory larger than any one of the states, and millions of people find their business favored and their prosperity and comforts enhanced by its existence. One of the most costly roads of the country, with extensive connections and feeders, has been created with almost exclusive regard to Baltimore business; and the road will prosper if the city prospers, and lose its importance if the city decays. A great number of private individuals and public and private corporations are interested in the stock and indebtedness of this railroad company, and would be subjected to embarrassment or suffering if it were forced into bankruptcy. For all these reasons the welfare of Baltimore is a matter of national importance, and it is so connected with the trade of the interior that its existence modifies beneficially all the markets. But its relations to the foreign trade are also such as to render it important to the whole civilized world.

But New York has some most decided advantages over Baltimore, of which its people have availed themselves with great ability and energy. The growth of that city has not been checked by the marvelous prosperity of other towns, and its relative superiority in both foreign and domestic commerce has been substantially maintained. Though Baltimore is much nearer the grain fields of the West, New York still draws to itself much the larger share of the harvests, and it has done this in spite of the fact that, with temporary and unimportant exceptions, the differential rates have at all times been largely against that city. Suppose now that under an application of the cost principle the differentials could be abrogated, what would be the effect upon Baltimore? Would it deprive that city of the share in the trade of the country which its location, its great expenditures and the skill and enterprise of its people have hitherto secured for it? Would it check the growth of the city, sap its prosperity, and bring ruin upon those everywhere whose business arrangements and investments have been made with a view exclusively or mainly to the trade of that city? And if so, would the result be one that the country could contemplate with satisfaction as the just result of the proper application of a sound principle, and that those having influence in railroad affairs could justly and properly plan for, labor for and shape their tariffs to accomplish?

On the other hand, suppose the strict application of the cost principle should be found to require that the differentials against New York should be doubled, would it be admissable to double them irrespective of all consequences to the trade and prosperity of that city? That these consequences might prove disastrous if the principle could be upheld and enforced seems certain, for it would give advantages to the town most favorably located for cheap commercial intercourse for which the others could have no compensation. But this very fact—if there were no other impediment—would render the application of the principle impossible. A great city possesses great powers of self protection, and it must exercise them to the fullest extent when the need comes. Great railroad corporations cannot, in their rivalry with each other, accept principles of action which must necessarily impoverish them. If the Baltimore & Ohio Railroad would lose its business under the application of the cost principle as between it and the roads north of it, it must accept less returns upon its business, and it must continue the struggle even though no more than operating expenses be realized, rather than submit to destruction without an effort at self-preservation. This or something like it must be the inevitable result, for neither cities nor transportation companies can or will accept a principle which it can be seen in advance must build up some on the ruin of the others.

But when it comes to applying the cost principle to the several lines which serve the same city, it is at once perceived that the difficulties are insurmountable. The application must of course be made on estimates of probable results, and the estimates will have in view a percentage of profits which it is expected or hoped will be realized. But with four or more lines of very different length competing for the same business, it is evident that cost must have, when applied to their business, very different meanings. If the shortest and cheapest line makes its charges on a calculation of say 10 per cent. profit, the longest and most expensive must conform to the charges, even though they be such as will insure no profit at all. One company may then carry at a cost which includes 10 per cent. profit, another at a cost which includes say 20 per cent. profit, while the third barely pays its operating expenses and repairs, but still obtains the cost of moving the freight. Competition obliges the companies to take what they can get, and to satisfy the demands upon them from it; but when the cost standard is so uncertain and elastic that it may include profits when they can be earned, and must exclude them when they can not be, it is evident that it cannot be a standard of general or just application. It is impossible that anything can be a governing principle, which, in the nature of things, cannot have the same meaning to the several parties who are to be affected by its application.

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[*] In Poor's Manual the aggregate cost of the railroads of this country and their equipment to 1881 is given at $4,653,609,567. The railroad companies paid in 1880, in dividends, $77,115,410; and for interest on bonded debt, $107,866,328. To 1882 the cost was $5,577,906,931. There was paid in 1881, in dividends, $93,344,200, and for interest $128,587,302. It will be seen that the dividends and interest together are about four per cent. on the cost of the roads and equipment; the dividends being much the smaller part. No doubt there is much "watered" stock, and a large allowance may be made therefor, without affecting the accuracy of the statement in the text.

That the cost to the roads themselves of moving their freights, irrespective of profits to shareholders, has much to do in determining the charges is, we think, unquestionable. It certainly must have influence so long as competition between lines exists, for the most economical line may fix rates on a consideration of what its favorable circumstances will enable it to endure, and all others must accept them whether they prove satisfactory or otherwise. One cheap line may thus give to a town the benefits of cheap transportation, not as an application of the cost principle, but because its favorable circumstances enable it to do so consistent with its own interests.

The idea was not put forward in any of the arguments that the application of the cost principle could be made universal, and that every railroad company should apply it in its own business as between the different kinds and classes of freight. The difficulty in doing this as a mere matter of accounting would be very serious, but there would be other difficulties which would be more important to the general public. The chief of these would be this: That very many articles would not bear transportation for the very considerable distances for which they are now carried if the charges upon them were graded strictly by the cost. If their bulk or weight is large in proportion to their value they must be carried cheaply or they cannot be carried at all; and freights are therefore classified in the tariffs so that the lighter but more valuable articles are made to bear a burden out of proportion to the cost of carriage in order that the roads which carry them may be enabled at the same time to serve the public in the exchange of articles and products whose value will not admit of like charges. Some discriminations of this sort are essential to enable railroads to answer the expectations and meet the needs of the public. It must often happen also that where two or more roads are competing for a particular business one of them must carry what it gets of it without profit and must find its profit elsewhere. If the competition under such circumstances leads to the road carrying one kind of traffic at a loss, which is made up by an increase of burdens on the remainder, a wrong is done of which complaint may justly be made. But there is no inherent wrong to any one in a road conveying without profit, but also without loss, a business which it must accept on those terms or decline altogether.

THE PRINCIPLE OF COMPETITION.

If neither distance nor cost gives us the governing principle, we must next see whether we are to find it in competition. In nearly every other kind of business the competition of those engaged in it is the great regulator of charges, and the operation of natural and familiar laws of trade prevents extortion and brings about substantial uniformity. Will competition do this in the business of transporting property by rail? If so, is not the competitive principle the true principle? And will not the competitive principle make cost and distance elements in the determination of rates and allow to each its just value according to the circumstances?

We should be glad to feel able to give to these questions an unhesitating answer in the affirmative. We have found, however, in the course of our investigations, that a species of competition has prevailed from time to time, which has brought satisfaction to few persons, if any, and which has resulted in inequalities and disorders greatly detrimental to trade. Such competition exists when the railroad companies, or those who are permitted to solicit business and to make contracts on their behalf, set out with the determination to withdraw freights from their rivals, and secure them for themselves, at all hazards, and regardless of gain or loss; and when, acting upon this determination, they throw to the winds all settled rates, and in the desperate strife for business offer any inducement in their power which will secure it. The country not long since had experience of such a season, and everywhere we listened to complaints of the injury which legitimate business suffered from it. It was said by parties interested in transportation that the inauguration of such a strife put an end for the time to all possibility of calculating from day to day what would be the cost of carriage, and what could be safely paid or wisely accepted for grain, provisions, or other articles, destined to another market by rail. The control of railroad rates, and, to a large extent, of all railroad business, then passed out of the hands of the legitimate and regular corporate managers into the hands of solicitors for fast freight lines and other agents, who made from day to day, and from hour to hour, such terms with those having business as would secure it, but generally made secret terms—that the bargain with one man might not prevent their driving a better bargain with another, as they might find opportunity. Under such circumstances persons were favored and localities were favored, when the object to be immediately accomplished seemed to require it, regardless of the just maxims of legitimate business, and of the rules of the common law, which enjoin upon common carriers that they shall deal with all customers upon principles of equity and relative fairness. Legitimate business, it was said, necessarily passes into an unsettled and speculative state while this condition of things exists; safe and close calculations are impossible; transportation becomes cheap, but neither producer nor consumer is certain to reap the profit, for the middleman cannot calculate upon steadiness in low rates, and as he takes the risk of their being raised upon him, so he is in the best position to appropriate the benefit while they continue. Meantime, railroad profits disappear, and dividends cease to be paid, to the great distress of thousands who rely upon them for their living; and every interest, in any degree dependent on railroad prosperity, must participate in the depression and disaster which accompanies the ownership of railroad shares.

The mere statement of these results is sufficient to show that this is not what in other business is known and designated as competition. Competition is the life of trade, but this is its destruction; competition brings health and vigor, and secures equality and fairness, but this paralyzes strength, and makes contracts a matter of secrecy and double dealing. In competition, the sound dealer, operating upon his own capital and upon well-established credit, has the best chance of success; but in the sort of competition we have mentioned, it is found that the bankrupt corporation has the advantage, for its managers, having nothing to lose, may offer rates which solvent roads cannot meet without being dragged into bankruptcy with them. Railroad managers do not concede that this state of things is properly designated competition, but they speak of it as an unnatural condition of railroad hostility; as unreasoning railroad warfare; as competitive strife, rather than competition. It is a state of things that, like a war between nations, from its very destructiveness, cannot be a normal condition, but must speedily terminate in peace or in disaster. It has usually been terminated by a common understanding between railroad managers upon a tariff of rates.

But this common understanding, it is urged in some quarters, eliminates competition from the sphere of railroad business, and we escape the evils of competitive strife by embracing those of monopoly. This is denied by railroad managers, who insist that understandings respecting the reasonable management of their business are not only entirely consistent with competition, but that they are the only means whereby the excessive competition at some points can be prevented from operating oppressively at others. It is, no doubt, true that competition tends to produce some great inequalities, and that care ought to be taken to prevent this. It should never be forgotten that the transportation of property and persons by railroad is not exclusively a private business, but is carried on under franchises granted by the State, which confer upon the owners functions of a semi-public nature, and charge them with semi-public duties. The railroad manager, operating under such a franchise, must harmonize the interest of his road with the public duty, and he cannot make self-interest the exclusive guide, as a merchant may, or a farmer. One of the chief of these public duties is to make only reasonable charges, and to regulate and apportion these among the customers of the road on principles of equity and relative equality. But the operation of competition is perpetually in conflict with this duty; it is felt unequally along railroad lines; it will be active at points where several lines can compete; it will be moderate at others where there is little to excite it, while at still others there can be no competition, because there is but a single road. But the capital of a railroad company is planted on a certain line; it must be made available to its owners there or nowhere; it cannot be removed when found unprofitable, as a merchant may remove his stock of goods; and the tendency of excessive competition is to cast upon the business of non-competing points a cost for transportation which puts them to great relative disadvantage, and in extreme cases may prove ruinous. The local traffic is likely to experience this result most severely, and the more completely any particular line occupies a territory, the more is the local traffic exposed to peril. The New York Central Railroad, with no connections west of Buffalo, would be a mere local road, and must find remunerative returns upon all its immense investments from the local business; as a great through line, it is enabled to cast upon through traffic a part of the burden which local traffic must otherwise bear; but if under the stress of unreasonable and excessive strife for through freights that class of freights is carried at a loss, this loss must either fall upon the corporate shareholders, or it must be cast by the corporation upon the shippers of local freights. It must be assumed that railroad boards will always seek to so arrange their tariffs of rates as to secure a satisfactory net profit; and if a part of the business pays too little, the remainder may be made to pay too much. This is not a beneficial result of competition, or one consistent with the obligations of the railroad companies to the public. No one disputes or doubts that for the general public the business of transportation by rail is in the most desirable state when it is so conducted that the charges for moving property are distributed with relative equality over all the business, so that a moderate profit may be reaped from all, and the support of the road, and profits to its owners, not be exacted wholly or mainly from one portion of the business to the exemption of the remainder. But it is only when it is in that state that railroad companies are complying with their common law obligation as carriers. If they are sacrificing the interests of one class of shippers in the reckless strife to obtain the business of another, it is plain that they cannot be dealing impartially or making charges which are relatively just. And certainly no city can be interested in having the trade which is nearest to it, and which is the trade of the people constituting its best and largest customers, sacrificed to the trade with the people at a distance, who deal with it much less.

It is a fact of which the railroad companies are entitled to the full benefit, that the charges for railroad service have steadily declined, even when the railroads have been so conducted as to avoid competitive strife. Mr. Poor, in his summary of railroad operations for the year 1881, prepared for his *Manual*, gives some striking figures on the subject of rates, and shows that within a quarter of a century the average charges for the transportation of property on three of the great railroad lines of the country have been reduced more than 70 per cent., and that the reduction has continued to go on until the present day. Some of the reasons for reduction are traceable to competition, and some not. The growth of railroad business has kept pace with the reduction of charges upon transportation, and the two have acted and reacted upon each other as cause and effect. When the merchandise or products of one section of the country, for which there was a demand in another, would not bear transportation at existing rates, the railroads have been compelled to reduce the rates as a necessary condition to obtaining the property for carriage; and the reductions which are made in some cases from necessity are made in others from policy, because it is found that they stimulate industry, build up manufactures, and bring profits to the railroad companies in the great increase of business which is thereby prepared for them. In all these cases the common interest of railroad companies requires that they should yield to any public demand for the reduction of rates so long and so rapidly as they find they can do so with justice to their shareholders; and they have generally found that the net results were such as, from a selfish standpoint, would fully justify the reductions. Common understandings between railroad companies in many such cases might tend to equalize and steady the rates, but would be grossly impolitic and unreasonable if they were directed to the maintenance of such freight charges as would operate as a check upon transportation, and thereby reduce their own net revenues.

But there are influences bearing upon the charges for the transportation of property which are beyond the reach of the railroad companies altogether, and which no combination among them can control. The transportation of the products and merchandise which the different sections of the country exchange with each other is only in part in railroad hands, and the carrier's by rail are at all times subjected to a competition which is not only active and vigilant, but is possessed of some most important advantages. It will readily be inferred that we allude here to the carriers by water. For the whole distance from Chicago to New York the owners of boats on lake and canal are bidding against the railroads for freights. Much of the time they are offering rates which the railroads cannot meet without loss, and during the season of water carriage they would take away from the railroads nearly all the heavy freights, if it were not that the more rapid transit by rail has some advantages of which shippers find it for their interest in many cases to avail themselves. But even with these advantages the railroads find themselves compelled to make their charges approximate the charges of carriage by water, or the great bulk of heavy freights will inevitably take the water route. Thus the competition by water operates in reduction of railroad tariffs, and no understanding among railroad managers can prevent it. When the Erie Canal is closed for the winter the railroad companies are enabled to advance their charges; but even in the winter they feel the competition of the water route; for excessive charges will not be paid, but grain, flour, provisions and other heavy articles, instead of going forward by rail at what seem to shippers extortionate rates, will be placed in store until the water route is again open. Nor is the competition with the water route felt exclusively by the roads to

New York; for unless the seaports to the south afford better markets for Western products than is found at New York, which they seldom or never do, the roads leading to them will be cut off from carrying these products if their charges are made to exceed the charges to New York. The favorable influence of the water route upon rates is therefore felt all the way to the Ohio and the Potomac, and the maximum of rates is fixed for all the roads by the roads to New York, with which the water route comes most directly and immediately into competition.

Under the competitive principle, a maximum of rates is thus established, and the railroad companies cannot prevent it, whatever may be their desire. But distance, cost, and many other circumstances may then come in to force still lower rates on the lines to the cities south of New York. If it is found that the roads leading to Baltimore will not obtain a reasonable share in the business without offering better rates than are given to New York, such rates will certainly be offered. They will submit to the rates which gives the business to other cities only until the trial proves the prejudicial operation. And when they reduce their charges, it will be optional to the New York roads to follow the Baltimore lead, and they may, no doubt, be relied upon to do so if their interests appear to require it.

But another most important factor in regulating freight charges is the export trade.

The prices of the leading American products, in the carriage of which the railroads compete most actively, are fixed in European markets. These products should net to the producer in the American market the foreign price, less reasonable charges for transportation and handling; and he is interested in having the trade open to the competition of as many buyers, and the transportation to that of as many carriers as possible. Of the Atlantic cities which compete for this trade, Baltimore and Philadelphia are dearest to the producer, but New York and Boston are nearest to the foreign market. Much is shipped to each of these cities for home consumption, but the major part of all that they receive is destined to a foreign market. Some of it passes from Western towns on through bills of lading to foreign ports, but the most of it is consigned to the merchants of the Atlantic cities, and is reshipped by them. Except at Boston, it has been found impracticable to distinguish between that intended for home consumption and that for foreign shipment; and, therefore, no discrimination in freight charges is attempted, but all is charged as if destined to a foreign market. But when so treated, the Atlantic cities become merely so many points on so many through routes between the interior of the country and the European ports, and the charges on shipments must regard the whole lines and not parts of them merely. On these several through lines, competing for the same business between the same interior American towns and the foreign ports, the whole charges, if the routes are equally favorable, must be substantially the same, or the one giving the best rates would obtain the business. The question of ocean rates must, therefore, have an important bearing on the inland rates; for if the ocean rates are greater from Baltimore to foreign ports than from New York to the same ports, the inland rates to Baltimore must necessarily be lower, or Baltimore will be excluded from the trade. Turning our attention, then, to the ocean freights, we find that during the year 1881, from Baltimore to Liverpool by steam and sail, they averaged nearly three cents per hundred pounds greater than from New York, and from Philadelphia nearly two cents greater. This is not conclusive of what they might be in another year, but it is indicative of a general condition of things. Besides this advantage in the ocean freights the New York route has a further advantage in the somewhat greater expedition. If, therefore, the railroads to Baltimore and Philadelphia were to charge for the inland carriage the same that is charged to New York, they must do so with the certain result of losing their present participation in the export trade. They must, therefore, of necessity, make their average inland rates at least as much lower than the inland rates to New York as will offset the differences in the ocean freights. This follows under the sway of competition from the same necessity which forces upon two merchants trading side by side in the same articles a concurrence in the same prices. Attempts by agreement or otherwise to counteract this law of competition would be of little avail, and of no avail, whatever, for any great length of time. All the leading articles of eastern bound freight would be affected by this principle and this would be so large a proportion of the whole as to govern the charges on all.

The differentials then appear to us to find their reason in competitive forces. A brief reference to their history will show that compact has not succeeded in controlling them. In 1869 there was an agreed difference in favor of Baltimore in the rates for the transportation of grain, of 10 cents per 100 lbs. But the effort to sustain this difference led to a war of rates, as a result of which it was reduced one-half. This lesser difference was maintained until 1876, when an agreement was entered into by the trunk line roads which based the rates on relative distances. But at the end of a month and a half the New York roads withdrew from this agreement, being satisfied that its operation was prejudicial to their interests. Then followed another war of rates, ending after a long struggle in the differentials now existing. The war of rates of 1880 was entered into to get rid of them, but it proved ineffectual, as before stated. They appear, therefore, to abide the tests of competition, and they have come, as prices generally do, under the exigencies of trade.

But it is, of course, possible that differentials may be just at one time and unjust at another; and it is insisted on behalf of New York that, whatever may have been the case heretofore, the existing differentials are no longer just to that city, and are no longer such as would result from a competition not hampered and restrained by railroad combinations. For evidence of the injustice, we are referred to statistics which show that the growth of Baltimore and Philadelphia trade, especially in grain and provisions, has in late years gained rapidly on that of New York. This, it is said, is proof that the differentials operate against New York interests, and the New York roads ought to abolish them by reducing their own rates until they conform to the rates on the lines leading to Baltimore and Philadelphia. This, it is insisted, is what fair competition requires.

It might, perhaps, be a sufficient answer to this demand, that the attempts heretofore made to force equality of charges, though long persisted in, with no small loss to the participants, proved unavailing. But passing that fact without further remark, we direct our attention to the evidences that New York has suffered from the differentials. These we have not found of much weight. It is certainly true that Baltimore and Philadelphia have now a larger share in the grain and provision traffic than they had fifteen years ago; but it remains to connect the fact with the existence of the differentials. For a long time New York nearly monopolized that trade; but the reasons were obvious in its better channels of communication with the interior, and its greater preparations to accommodate it. When Baltimore and Philadelphia had extended their railroad systems so as to compete for the trade, and had provided elevators and other conveniences, they immediately took a share in the business; not because of the differentials, but because they were then prepared for it. But no evidences were produced before us that the Philadelphia and Baltimore business, to which the differentials are applicable, is now increasing more rapidly in proportion than that of New York, or that the growth of New York business is, to any extent, checked by them. On the contrary, there is abundant evidence that New York is fully maintaining its present lead, and that its trade is enjoying a growth so healthy and vigorous, that its commercial classes can well afford to regard, without envy or regret, the prosperity of other places, and may well concede to them, without repining, all the advantages which have come to them as a result of competitive efforts. The accompanying note will show the relative proportion of the total receipts of grain and flour at the four Atlantic ports which was received at each, and it will appear from the figures, that New York, during the last eighteen months, has gained on the others.* How far ephemeral causes have contributed to this gain we can not know, but it is manifest that the evidence that New York suffers from differentials does not yet appear.

As the interior is interested in the subject of differential rates, and as the sharpest competition in freights is encountered there, so that its commercial classes are in favorable position to judge of the forces affecting them, it has seemed to us no weak evidence of the justice and necessity of the differentials that the preponderating sentiment in the interior was strong, and decided that the differentials were just. There was, indeed, some dissent, but this was the prevailing view.

In our discussion thus far, we have had but little to say of the case of Boston, or of the westward-bound freights. As to the latter, some of the considerations above mentioned would not apply, but the differences are not sufficient, as we think, to relieve New York westward-bound freights from the differentials. We were not invited by the commercial organizations of Boston to visit that city, and we refrained for that reason from doing so. We have reason to suppose that the seeming want of interest in Boston in the subject referred to us was due to the fact, that no one seemed disposed to make any controversy in respect to the rates to that city. Boston claims the same rates with New York on the export trade, and the other cities do not appear inclined to contest the claim. This makes the charges less on foreign-bound freights than upon those delivered in Boston and other New England towns for home consumption; and to that extent works an apparent injustice. If the low charges on foreign-bound goods have the effect to increase the charges on freights for home consumption, it is an injustice in fact; but if not, and the Boston roads consent to carry at the low rates as a necessary condition to participation in the foreign trade, the other cities cannot well contest their right to do so. As the ocean freights from Boston correspond very closely to those from New York, the principal already stated is applicable; and we have no occasion to consider the case of Boston separately.

CONCLUSION.

It only remains for us to state that no evidence has been offered before us that the existing differentials are unjust, or that they operate to the prejudice of either of the Atlantic seaport cities. Differential rates have come into existence under the operation of competitive forces; they bear some relation to relative distance and relative cost of service; they recognize, as we think, the relative advantages of the several seaports; and they are subordinate to the great principle which compels the carriers of property competing between the same points and offering equal facilities to their customers, to make the same rates. We therefore cannot advise their being disturbed.

But we do not assume that the rates which are just to-day will be just indefinitely. They have become established by the force of circumstances, and they ought to give way if future circumstances shall be such as to render it right and proper. They constitute a temporary arrangement only; equitable, as we think, for the present, but which may become inequitable before the lapse of any considerable time. Whenever they shall be found to operate unfairly, and give a forced and unnatural direction to trade, and whenever it shall appear that they tend to deprive any one of the seaports affected by them of the proportion of business that would naturally come to it under the operation of normal competition, the want of equity in the rates will appear, and it will be right to modify, or, perhaps abolish them.

Railroad problems assume such different phases from year to year, and almost from day to day, that those who have authority in railroad matters may justly be expected and required to give their earnest attention and best efforts to making their franchises accomplish the great ends of equal, fair, prompt and beneficial accommodation which was intended in their grant. And those ends they should have in view in determining upon the continued existence of differential rates. Their observation of the general course of traffic from day to day and from month to month ought to enable them to determine whether the differentials are too large or too small; whether they are influencing trade unfairly and unnaturally, and whether they operate as an improper restraint upon competition, and when the improper effect is discovered they ought to correct the wrong without hesitation or delay. To enable them to judge fairly and with full understanding, accurate statistics of their business should be kept by each of them, and submitted to the others or kept in some common office, and these statistics ought to be periodically given to the public also. Publicity is a great corrector of imaginary evils, and may be an important preventive of evils, both imaginary and real.

We do not assume or believe that there exists in railroad official circles any legitimate authority to determine the question of rates arbitrarily. Large powers of self-government have, undoubtedly, been left by the law in railroad managers, but all their authority is qualified by duty to the public: and it cannot be too often or too pointedly asserted that the obligation on their part to serve the public with relative fairness is of perpetual force. In their future dealings with the important question which has been the occasion for our coming together, the great trunk lines should be particularly careful to give no occasion for just complaint, that they subject any one of the seaboard cities to the operation of arbitrary or unfair regulations or charges, or that they fail to observe towards any of them, or towards the people trading or desiring to trade with them, the mandate of the common law—to deal justly and distribute fairly the benefits and burdens which are incident to their occupation.

Allen G. Thurman,
E. B. Washburne.
Thomas M. Cooley.

New York, July 20, 1882.

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*	1878.	1879.	1880.	1881.	6 mo. 1882
New York	56.	52.6	53.5	56.5	62.9
Boston	10.	10.6	11.7	14.3	16.8
Philadelphia	16.7	15.3	15.6	11.7	11.6
Baltimore	17.3	21.5	19.2	17.5	8.7
Total	100.	100.	100.	100.	100.

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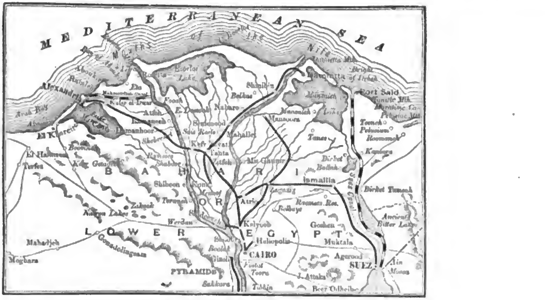
The Columbus & Eastern Railroad Company has the engineers at work making the locating survey from Columbus to a new and undeveloped mineral field in the eastern part of Berry County. The syndicate, on which the railroad enterprise is based, has optioned about thirty thousand acres of mineral lands, rich in coal, iron ores, fire and potter's clay, and the directors propose to have the cars running from Columbus to Selby's Pass, a point three miles northeast of New Lexington, by the 1st of next January. The mineral field to be made accessible by the construction of this road is second to none in the state.

THE WAR IN EGYPT.

Over the actual condition of affairs in Egypt, as regards the position and intention of Arabi Pasha, hangs a cloud of impenetrable darkness, and although every paper receives articles almost daily "from its own correspondent" on board one of Her Majesty's ships, no paper obtains letters direct from the camp of Arabi. His words and actions would undoubtedly be of interest to the public, yet they are not chronicled.

The accompanying map gives a general idea of the lower portion of Egypt, and the location of the great canal and railroad lines. The main interest of the civilized world gathers around the canal, and the doubt and anxiety concerning Arabi's power and intention in regard to it give the whole subject an amount of attention it would not otherwise receive.



MAP OF LOWER EGYPT.

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THE DEAN STEAM PUMP WORKS.

From a late issue of the Indianapolis *Herald* we clip the following:

Indianapolis is fast assuming an important position among the manufacturing cities of the West. Her rolling mills, tile works, the Atlas engine works, are second to none, and supply the trade throughout the entire country. The steam pump works of the Dean Brothers, is another important manufactory that will well repay a visit. They have been established in Indianapolis for 12 years, having come to Indiana in 1870, from central New York. From an ordinary beginning, their business has increased until they now employ over 100 men, and send their pumps to every part of the United States. This growth has necessitated the building of new shops and office, which are a revelation to builders and manufacturers in this part of the country. They have combined with convenience, space and excellence, an artistic effect that is extremely attractive. The latter is particularly fine, and may be taken as an example of what æstheticism, in the best sense of that abused word, will do toward converting a place of business into a beautiful structure that time will only render more picturesque. The shops extend along Madison avenue and Ray street, and are 320 × 50 ft. They are well lighted and ventilated, a track running the entire length for convenience in moving machines. There is an office for the superintendent of the shops, with speaking tubes connecting it with the main office. The buildings are of brick, with trimmings of black brick and cut stone.

The main office stands at the corner of Ray street and Madison avenue. This is in the Elizabethian style, with tile roof and half timbered work under the cornices. The windows on the first floor are very artistic, the lower sash being of New Albany plate glass, while the upper are stained glass from Utica, N. Y., the design being very original and the color brilliant though sufficiently subdued. The wood-work is of oil-finished black walnut, the carving has been done by hand. The vestibule into which the visitor is first ushered, is paved with black, red and cream-colored tile. A handsome counter of black walnut supplied with drawers and shelves, extends across the vestibule, separating it from the main office, which is entered by a pretty gate of black walnut, also carved. The main office is lavishly supplied with handsome desks and chairs. The heating is done by steam, but there is also in this apartment a grate with a beautiful mantel and hearth of white, brown and cream-colored tile. A large fire-proof vault for papers and drawings, a wash-room supplied with hot and cold water, and a private office which is to be elegantly fitted up, open out of the main office. The room above is finished in white pine. This is well lighted and is used as a draughting room and mailing department, from which large quantities of circulars and lithographs are sent daily. The windows of this room are also noticeable—the lower portion being a single pane of plate-glass, while the upper contains many small panes. The effect is exceedingly quaint and pretty.

The handsome landscape painting ornamenting the door of the large safe in the office, is the work of Mary H. Krout, of Crawfordsville. The deft manner in which the brush has been handled demonstrates that the author of "Little Brown Hands" can paint with the brush as well as with the pen, and that she is an artist as well as an author.

All the draughting and casting is done under their own supervision, drawings, patterns and castings being all made in their own shops. There is nothing that will secure such excellence as personal attention to one's own business, whatever it may be. No amount of money will secure the same carefulness and dispatch as is secured by the man who looks himself to see that his orders are obeyed. This probably explains the rapid growth of their trade, since it accounts for the excellence of their work.

Besides many other important commissions, they have this year supplied Edmore, Michigan, with water-works machinery, the Du Pont paper mills, of Louisville, with two pumps capable of delivering one million gallons in twenty-four hours, a large pump for the Chattanooga iron works, and are now making some fine machinery for the new steel works of this city, and have received an order from Peoria to supply a distillery with a pump to cost four thousand dollars. A pump of their manufacture is used in the Sibley College of Mechanical Arts, Cornell University, for illustration and experiment.

There is no reason why men should reserve all their choicest possessions for their homes. Two-thirds of a business man's time, at least, is spent in his office or shop. Dust, confusion, bad air, spittoons, ink-stained desks and dilapidated chairs generally render these places cheerless and dreary in the extreme. Such things can not fail to have a dire effect upon the health and spirits, and consequently upon the minds and energies. Surroundings that are pleasant and comfortable may therefore be regarded as the best of all good investments, and the example set by this prosperous firm is well worthy of imitation, not only here in Indianapolis, but wherever men work and build.

RAILWAY TRAVEL IN EUROPE AND AMERICA.

Mr. Robert S. Minot, of this city, has prepared, and Messrs. A. Williams & Co., have published, a pamphlet entitled "Railway Travel in Europe and America," which is crowded with facts interesting both to those who are travelers and to those who are not. His primary postulate is that the progress of civilization is more or less co-extensive with the progress of means of communication and transportation, and he cites the railway and telegraphic development of eastern and western Europe and that of this country to support this proposition. Travel, he says, is a sort of education; hence those who are eager for self-improvement, and race-improvement, must desire that railroads and steamboats should be brought to such perfection that the Atlantic may be crossed in a week for half the present fare, that New York and San Francisco may be within three days of each other, and that the journey around the world may be made in a month or six weeks, all of which may be realized within the present century. It has been proved that the average traveler may journey millions of miles on land and sea with perfect safety, that a new-born babe must travel incessantly at the rate of forty miles an hour for about a century in order to run the average risk of being killed by a railroad, and for about twenty-five years to sustain any injury whatever.

In a comparison of the methods of railway travel followed here, where baggage is not weighed, and in Europe, where it is weighed, it is said that in this country not more than ten minutes is wasted in preliminaries, while in Europe at least half an hour must be allowed for them; that the waiting-rooms on this side the Atlantic are warm and stuffy, on the other side cold and stuffy, while the cars are subject to the same criticism. The foreign first-class railway carriage is equal in appearance to the best American car; it is lighter in proportion to its length, and therefore on good roads it runs with a smoother motion; it is better stuffed, and is provided with a head support. Because of these advantages, travel in it is much less tiresome than that on American railways; but this is offset by the passenger being locked in his compartment; by the lack in cold weather of artificial heat, and by the absence of all toilet appliances. As for American palace cars, for long journeys at least, there are no superiors. Many second-class foreign carriages are quite as comfortable as are those of the first-class, but those of the third-class are mere cattle vans with wooden seats for the human bipeds who may occupy them. On foreign trains the usual fares are four, three and two cents per mile, according to class, with extra charges for express trains, fees to officials and payments for above 50 pounds of baggage, making first-class European travel more costly by from one to two cents per mile than that in palace cars in the United States east of the Mississippi River. In Europe generally, and in France especially, such stops are made by long distance trains, whether they are or are not on time, that all their passengers have ample opportunity to eat with comfort and security to the full satisfaction of their hunger.

For number of trains and for speed, England leads the world. From London to Grantham, 105¼ miles, the running time is 2 hours 3 minutes, nearly 52 miles an hour; from London to Bedford, 50 miles, the run is made in 54 minutes, or at the rate of 55¼ miles an hour. The new Chicago lightning express averages 36.75 miles per hour; that between New York and Boston maintains a speed of 38.38 miles per hour. The fastest train in France—that from Paris to Bordeaux—runs about 360 miles in 9 hours. The chief Brussels expresses run about 29 miles an hour in France and 38 miles an hour in Belgium. The fastest train in Germany—the Paris train from Berlin and Cologne—runs at the rate of 40 miles an hour until it reaches French territory, when the rate drops to 27 miles an hour. Austrian trains run slowly, but charges for them are low; Holland and Belgium have high speed and low fares; Italy and Spain show, considering their mountainous territories, fair speed; Russia, Portugal and Switzerland make fair showings. Railway civilization in America holds a westerly course. In the Middle States the best speeds are shown; New England is a very good second; in the Western States no notable speed is to be found; in the Northwestern and Southwestern States and in the Far West speeds continue to diminish until the confines of civilization are reached. The Wisconsin Central Railroad carries off the palm in the slow race, having a record of 351 miles in 52 hours 20 minutes—6¾ miles per hour. The effects of heavy grades and curves is well shown by travel on the Boston and Albany Railroad; in the Berkshire Mountains, where the maximum grade is more than 80 feet to the mile, a train of six cars and two locomotives makes on up grades from 21½ to 30 miles an hour; on down grades 44 or 45 miles an hour. On the Old Colony Railway, on a local express to Middleborough, a train of ten cars, with one locomotive, averages in clear running speed 40 miles an hour. On 140 European routes, the average speed of the fastest 140 trips exceeds that of the slowest 140 trips by 46 per cent.; in America such excess is only 25 per cent., and it is almost entirely due to the omission of stops by express trains. In Europe the nominal differentiation in fares is 114 per cent.; in America it is zero. The conclusion is that one important reason for the absence of great speeds in America is this lack of differentiation of charges; if three rates of fare were established the postal American express trains would run 10 per cent. faster, and the slowest 10 per cent. slower.

In great through travel the average speed in Europe is 23.12, in the United States 24.31 miles per hour; the average fare in Europe, 2.74 cents permile, is raised to 3.02 cents adversely to great through travel, while in the United States the average, 3.79 cents per mile, is lowered to 2.88 cents in favor of such travel, a practical illustration of the blessing of union and concord in a great country. In the advance of civilization the highest speeds are concomitant with the lowest fares, and this law will be brought forward more prominently by considering that the true estimate of cheap fares is the distance that the laboring man can travel on a day's wages. In France a workman gets 60 cents a day, which would carry him less than 30 miles third-class; in Italy and Spain perhaps 20 or 30 cents a day, on which he could travel only 10 or 15 miles. In the United States the workman can travel 40 or 50 miles on a day's wages; in New England and the Middle States, 60; in the far West about 25; in the South possibly still less. The present American system of railroad travel is based on two grounds, that it is much easier to run trains with one class of carriages than with three classes, and that all the people are in theory at least, socially equal. The European system is, however, the truly democratic one, for how can it be said that Americans are pecuniarly free and equal when the poor man must pay three cents to go a mile by rail while Vanderbilt and Jay Gould ride free? Differentiation of railway fares rests only on the difference of means; uniform rates mean that the rich may go freely where they please to seek better fortune, while the poor must remain where they are, no matter how unfortunate they may be. There should also be a reduction in the weight of cars; it is said that the American passenger train is usually over twice as heavy as the English train for an equal number of passengers. American railroads are apparently safe enough for use upon them of lighter vehicles; if they are not, safety should be secured in some way other than by compelling each traveler to carry about with him a ton or more of wood and iron.

In England, some of the principal trains are run thus: London to Edinburgh, 400 miles; fastest time, 9 hours; slowest time, 14 hours 25 minutes. London to Liverpool, 120 miles; fastest, 4 hours 50 minutes, slowest, 8 hours 20 minutes. London to Leeds, about 200 miles; fastest, 4 hours; slowest, 9 hours 25 minutes. London to Manchester, 190 miles; fastest, 4 hours 40 minutes; slowest, 6 hours, 50 minutes. London to Bristol, 118 miles; fastest, 2 hours 36 minutes; slowest, 4 hours 40 minutes. London to Brighton, 50 miles; fastest, 1 hour 10 minutes; slowest, 2 hours 30 minutes. In France—Paris to Bordeaux, 363¼ miles; fastest train, 9 hours 7 minutes; slowest, 16 hours 30 minutes. Paris to Marseilles, 535¼ miles: fastest, 14 hours 42 minutes; slowest, 29 hours 25 minutes. Paris to Strasbourg, 311 miles; fastest, 10 hours 27 minutes; slowest, 16 hours 37 minutes. Paris to Cologne, 306 miles; fastest, 11 hours 10 minutes; slowest, 17 hours, 5 minutes. Paris to Calais, 184¼ miles; fastest, 5 hours; slowest, 9 hours 35 minutes. In North Germany, Berlin via Magdeburg, to Cologne, 362¼ miles; fastest, 9 hours; slowest, 19 hours 5 minutes; Berlin to Bremen, 211 miles; fastest, 6 hours 35 minutes; slowest, 9 hours 23 minutes; Berlin to Hamburg, 177¼ miles; fastest, 4 hours 45 minutes; slowest, 8 hours 50 minutes. In South Germany, Dresden to Prague, 119 miles; fastest, 4 hours 38 minutes; slowest, 7 hours 15 minutes; Dresden to Munich, 300 miles; fastest, 14 hours 51 minutes; slowest, 17 hours. In Austria—Vienna to Munich, 266 miles; fastest, 9 hours 45 minutes; slowest, 17 hours 55 minutes; Vienna to Prague, 217½ miles; fastest, 7 hours 20 minutes; slowest, 11 hours 56 minutes. In Russia—St. Petersburg to Moscow, 401 miles; fastest, 22 hours 30 minutes; slowest, 28 hours 10 minutes; Warsaw to Moscow, 810 miles; fastest, 38 hours 24 minutes; slowest, 49 hours 18 minutes; Warsaw to Odessa, 842 miles; fastest, 40 hours 32 minutes; slowest, 49 hours 25 minutes. In Italy—Turin to Brindisi, 681 miles; fastest, 27 hours; slowest, 27 hours 57 minutes; Florence to Rome, 195¼ miles; fastest, 7 hours 50 minutes; slowest, 13 hours 10 minutes.

The following are some of the distances and speeds on this side of the Atlantic: Boston to New York, 226 miles; fastest, 6 hours 33 minutes; slowest, 9 hours 43 minutes. Boston to Montreal, 338 miles; fastest, 11 hours 35 minutes; slowest, 14 hours 50 minutes. Boston to St. John, N. B., 450 miles; fastest, 22 hours 40 minutes; slowest, 23 hours 5 minutes. New York to Chicago, 902 miles; fastest, 29 hours 10 minutes; slowest, 36 hours 55 minutes. New York to Cincinnati, 757 miles; fastest, 24 hours 30 minutes; slowest, 27 hours. New York to St. Louis, 1,065 miles; fastest, 35 hours 3 minutes; slowest, 38 hours 52 minutes. New York to New Orleans, 1,895 miles; fastest, 54 hours 41 minutes; slowest, 60 hours 44 minutes. St. Louis to New Orleans, 700 miles; fastest, 34 hours 34 minutes; slowest, 35 hours 21 minutes. St. Louis to Galveston, 870 miles; fastest, 46 hours 17 minutes; slowest, 50 hours 28 minutes.—*Boston Journal.*

ELECTRIC LIGHTING IN THE CITY.

A report to the Streets Committee of the Sewers Commissioners has recently been presented by Mr. William Haywood upon the prolonged experiment of street electric lighting, which was commenced in April, 1881. This experiment was undertaken on the action of the Streets Committee, who were requested in March, 1880, to consider and report upon the adoption of an improved mode of lighting the city streets. The Committee considered it advisable that a trial should be given to the electric light, and in this view they were sustained by the Bridge House Estates Committee, who were also desirous of trying the experiment. These two bodies co-operating, decided upon lighting certain of the main thoroughfares, including London, Southwark and Blackfriars bridges, and it was arranged that while the Sewers Commissioners should undertake the management of the trial, the Bridge House Estates Committee should pay the cost of lighting the bridges above mentioned. Acting upon this determination, tenders were applied for in the autumn of 1880, and were received from six different contractors. The area to be lighted was divided into three groups, and the tenders of three contractors were accepted. The main conditions of the experiment were, that it should extend over twelve months; that the lighting should continue each day from sunset to sunrise, and that no gas should be used except as a substitute during the period of trial. The first district included a length of streets of 1648 yds., and an area of 39,867 square yds. It comprised Blackfriars Bridge; New Bridge street; Ludgate Circus; Ludgate Hill; the north side of St. Paul's Churchyard; and Cheapside from its western end to King-street.

The second district, 1708 yds. in street length and 27,394 square yds., comprised Southwark Bridge; Queen Victoria street; Queen street, between Queen Victoria street and Upper Thames street; and Queen street-place.

The third district, 1,521 yards in length and 33,321 square yards in area, included London Bridge; Queen street, between Queen Victoria street and Cheapside; Cheapside, between King street and the Poultry; King street, Guildhall Yard; the Poultry; Mansion House street; the open space in front of the Royal Exchange; King William street, and Adelaide street.

In October, 1880, the lighting of these three districts was allotted as follows: To the Anglo-American (Brush) Company, District No. 1, at a cost of £1,410; to the Electric and Magnetic Company (Jablochkoff system), District No. 2, for £2,930; to Messrs. Siemens Brothers, District No. 3, for £3,729. The second named company failed to carry out their contract, which was assigned to the Electric Light and Power Company, but so much delay occurred before this company completed their work that the twelve months of trial will not be completed before April next, so that the present report deals almost exclusively with Districts Nos. 1 and 3. Dividing the amount of each tender into permanent works and cost of lighting, the three accepted tenders stood as follows:

	For works.	For lighting	Total.
	£	£	£
District No. 1, Brush	750	660	1410
" No. 2, Electric Light and Power Company.......	1470	1460	2930
District No. 3, Siemens........	1450	2270	3720
	3670	4390	8060

The quantity of light given for each district did not vary in anything like the proportion of the cost, as will be seen from the accompanying table:

	Number of lamps.	Nominal candle power per ramp.	Total nominal power.
District No. 1......	33	1000	33,000
" No. 2......	32	1000	32,000
" No. 3......	6 large.	5000	30,000
	28 small.	300	8,400
	99		103,400

These lights replaced 156, 157 and 139 gas lamps respectively, each giving 14 candles, and representing a total illuminating power of 6,328 candles, so that the electric light was about 16.3 times greater, while the total cost for gas during the year would have been £2,000, as compared with the £4,390 for the electric light: rather more than twice the cost of gas for sixteen times the quantity of light. In making this comparison, however, it is only fair to point out the great difference in the prices charged by the various contractors; thus for the three districts, the relative cost of gas and electricity stood as follows:

	Cost of Gas.	Cost of Electric Light.
	£	£
District No. 1, Brush	690	660
" " 2, Lontin..........	700	1,400
" " 3, Siemens........	612	2,270

The Brush lamps gave approximately 15 times as much light as the standard gas lamps; Lontin gave 14¼ times, and Siemens 20 times as much light. The area thus illuminated was in all 100,512 square yards, or 1,015 square yards on an average for each of the 99 lamps; the area lighted by gas averaged 222 square yards per lamp. It is not necessary to describe here the different modes by which each company carried out its work, for this we may refer the reader to *Engineering*, vol. xxxi., page 385. But we may mention that the Brush Company and the Electric Light and Power Generator Company were very favorably situated, inasmuch as they were enabled to feed the lamps from their factories, while Messrs. Siemens were obliged to establish a special power station. Considering that each of the contracting companies furnished nearly the same quantity of light, it is not easy to understand the wide differences that existed in the prices charged. The most interesting part of Mr. Haywood's report is that referring to the defects observed during the year. For the reason above stated, only Districts Numbers 1 and 3—Brush and Siemens—are reported on, the results in District No. 2 being incomplete. In District No. 1 there were 33 lamps in operation, each burning normally through the year 4,300 hours, or 141,900 hours in all. There was a total of 600 failures reported, the aggregate extinction of the light having equalled 3,142 hours of a single lamp, or 2.21 per cent. of the entire years' lighting. In District No. 3 (Siemens) there were 34 lamps burning for a total of 146,200 hours during the year. In this district the total number of failures was 320, equal to an aggregate of 837 lamp-hours, or .57 per cent. of the total lighting.

On analyzing these stoppages we shall find that considerable deductions must be made from each, before estimating the practical value of the systems for street lighting. The Brush lamps were started on the 29th of April, and on the 2d of May it was found that the insulation of the main conductor was defective, and a new cable had to be substituted; this caused a delay of seventeen days, on nine of which the system was not in operation, and a total loss of 2630 lamp-hours occurred. In the third district also, five days after starting, the conducting cable was damaged by barges passing under London Bridge, and a total of 340 hours was lost in the illumination. It is clear that the extinction from these causes have to be eliminated, as they were due to no defect in the systems, but to imperfect installation. There was, therefore, during the year, apart from these accidents, a loss of 512 hours in the Brush district, and of 492 in the Siemens, showing a slight advantage to the latter system, though for all practical purposes both were identical. It will be interesting to classify roughly the reported causes and extent of these extinctions:

	Brush. h. m.	Siemens. h. m.
Accidents to driving machinery	209.30	128.0
Through malice	.23	0.0
Defective carbons	6.10	214.0
" or dirty lamp	112.7	144.0
Carelessness of attendants	26.13	0.0
Broken lamp post	103.0	0.0
Carbons burnt out	18.48	5.0
Short circuiting	0.0	7.29

The number of lamps affected by the delays as explained by the companies are as follows, exclusive of the accidents to conductors already referred to:

	Brush.	Siemens.
Defective machinery	180	128
" carbons	24	124
Miscellaneous	62	36

The most striking feature in the above statement is the difference in the delays to the two systems caused by the carbons. In the Brush only 24 instances were recorded, involving a little more than six hours' delay on the year, which is practically nothing. On the other hand, the Siemens lamps were interferred with 124 times, and for 214 lamp hours, or more than 30 times as much as the Brush. This is simply a question of detail, and proves what has always been claimed for the Brush system—the excellence of its carbons. It proves also that so far as carbons are concerned there is no difficulty in the solution of the problem of efficient street lighting by electricity. On the other hand, in the delays arising from breakdown of machinery, motors, or generators, only 128 hours' delay occurred in the Siemens system as compared with 209 in the Brush, and it is evident that while accidents are unavoidable, if proper precaution be taken in duplicating machinery, the delays arising from this cause can be reduced to such an extent as to be practically inappreciable. Still more striking is the difference in the trouble caused by carelessness, for while Brush lost 26 hours from this cause, Siemens lost no time at all. Of one of the other causes, the broken lamp-post which resulted in 103 hours' delay in No. 1 district, it is clear that this must be classed among the unavoidable contingencies, although it must be borne in mind that the extinction of an electric lamp is a far more important matter than that of a gas lamp lighting only one-fifth the area.

It will be seen, we think, that the comparison made between the two systems after this extended trial is very satisfactory, because it proves that the chief proportion of the causes of extinction are easily to be avoided, excepting perhaps as regards the lamp mechanism which will probably be simplified as time goes on. It will be noticed that the delays from this cause were nearly equal in both systems, but while the majority in the Brush system arose from defective mechanism, nearly all the Siemens are reported as "Lamps required cleaning."

It may be mentioned as an interesting fact that the total number of gas lamps in the city of London is 3,225, and the number of badly defective lights noticed during 1881 was 2,509, a very large proportion, but which is neither so noticeable nor so important as a much smaller amount of defectiveness in the electric lights, on account, as above mentioned, of their greater power and smaller number.

In a report of the Streets Committee to the Commissioners of Sewers, some detailed information is afforded on a proposed project to extend the experiment of electric lighting in the streets to four districts, one of which is the District No. 3 of last year. Eight tenders for this work were submitted, with the following general result:

	Tenders ranged from			Cost of gas.
District No. 1	£2,100	to	£8,750	£551
" " 2	2,350	to	4,270	363
" " 3	2,479	to	3,860	341
" " 4	2,930	to	4,350	612

Some of the contractors coupled with their tender the request to be allowed to light private premises within the districts, and in one case the company offered to make the charge for lighting (not including installation) 20 per cent. more than the cost of the gas saved. None of the proposals made were of such a character as to justify the Streets Committee in recommending an extension of the experiment, particularly as by the Bill now before Parliament, and the amendments suggested by the Board of Trade, it is proposed to give power to local authorities to supply electricity not only for public but for private use; until this important question has been settled, the Committee deem it unwise to incur further expense in the matter.

It has been decided, however, to continue the lighting of District No. 1 for another year, the Anglo-American (Brush) Company having undertaken the work for £800. An offer was made to Messrs. Siemens to continue the lighting of District No. 3 for twelve months further, but the sum they asked (£3,600) was considered too high, and the Commissioners have returned to gas in this district. We should mention in conclusion that Mr. Haywood speaks very favorably of the Edison incandescence lighting on the the Holborn Viaduct, and promises a special report on this installation, as well as on that in district No. 2, which is being lighted with Weston lamps by the Electric Light and Power Generating Company.—*London Engineering.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 272.)

CCCLXXI TOMBSTONE.

Tombstone, Arizona, in lat. 32° N. long. 110 W., is a mining town settled about 1878.

There is no water attainable at the site of the town. The first water supply was introduced by a private corporation from Sycamore Springs at the base of the Dragoon mountains, eight miles north of the town and conveyed by wrought-iron pipe to two small tanks 50 ft. above the town. Another supply was introduced by the Tombstone Water, Mill & Land Company from a stream 2½ miles west of the town, whence it is conveyed to a reservoir of 110,000 gallons capacity on Comstock Hill near the town.

In 1881 and 1882, the Huachuca Water Company constructed works, just completed, taking the supply from the head of Miller's cañon between the two highest peaks of the Huachuca mountains, 25 miles south of the city. A reservoir, 100 by 80 ft. and 22 ft. deep, 1,000 ft. higher than the town, collects the water, and from this it is conveyed 25 miles by a 7-inch wrought-iron pipe down the cañon, across the San Pedro Valley 1,900 ft. lower than the source, and up again to a reservoir excavated in rock 365 ft. above the principal street of the city. It is 90 by 80 ft. and 20 ft. deep, lined with stone masonry and floored with Portland cement concrete. The supply pipe from the Huachuca reservoir receives on its way additional water from a spring in a lateral cañon which is introduced through a 3-inch pipe under 1,800 ft. head, and also from Carr's Cañon, the water from which is led into the main by a 5-inch pipe 4 miles long.

The distribution is by wrought-iron pipes. Two 7-inch pipes lead from the reservoir to the principal streets through which 6-inch pipes are laid, with 3-inch pipes in the cross streets. There are 58 fire hydrants.

The works have cost $300,000. The capacity of daily supply is estimated at 800,000 gallons.

Further information has not been obtained.

TO BE CONTINUED.

CORRECTION.

THE SOMERVILLE, N. J. WATER-WORKS.—In our description of these works last week the daily capacity of the four "multifold" filters was stated to be 1,500,000 gallons. It should have read 500,000 gallons, the beds being 20 inches deep.

CORRESPONDENCE.

"AN IMPROVED LEVEL."

NEW YORK, Aug. 3, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: I notice in your valuable number, July 15, a lengthy description of improved Y level, purporting to be patented by W. Gardam & Sons, of this city.

As *their* so-called improvement is a clear infringement on my patent right, which they acknowledge, as to center and seat attachment, tangent screw moving with bar, protection of center from dust, etc., and arrangement for holding telescope in truly horizontal position, I take this opportunity of informing those engaged in the manufacture of engineering instruments, as well as those using them, that I shall institute legal proceedings against the above named and all those unlawfully infringing on my patent right, of which number and date of issue are hereby annexed, and which may save trouble and expense to those engaged in making improvements.

No. of patent, 201,155; date of issue, March 12, 1878.

In justice to the above facts, you will please publish same, and oblige

Very respectfully,
F. E. BRANDIS, 55 Fulton st., New York.

THE WEST SHORE RAILROAD.

The public scarcely realizes the extraordinary degree of energy which the New York & West Shore Railroad is displaying in the pushing of its great enterprise through New York State. Taking into account the extent of the work now under contract, and the extraordinary character of much of it, in the tunneling, excavating and bridging required to complete the road bed at many points, it may safely be said that no work of equal magnitude was ever before pushed as this is now being pushed, either in this country or in the world. It still remains a mystery to the general public where the capital for the undertaking comes from, and it is altogether a mystery what its affiliations are to be when completed. Whatever its source, the capital has thus far been steadily forthcoming, under circumstances which leave little room for doubt that those behind the road not only mean to complete it, but to subsequently own and manage it. Something of the great cost of the undertaking can be imagined from the fact that the right of way for the West Shore road is costing more than was ever paid before in this country for the right of way for an equal distance. The road runs the whole distance through populous and valuable lands, and through the heart of numerous cities and villages. To secure a right of way under such circumstances is a very different undertaking from that entered upon by the projectors of new railroads in the Western country, or by the New York Central road at the time of its construction. That the West Shore road will be the most expensive railway ever constructed over a similar distance may be safely taken for granted. The compensation lies in the fact that immediately upon its completion it will enter upon the fruits of a business, both through and local, already built for its enjoyment—equal, in all probability, to that of any of its long established rivals. Notwithstanding this fact, there are careful students of such problems who express doubt whether such a road can earn enough at prevailing freight rates to make fair returns upon the enormous cost of construction. There can be no question that there is room for more trunk roads than this country now possesses for the movement of Western products to the seaboard. The West Shore road will have its full quota of business without affecting that of other roads. Within ten years the same thing might safely be said regarding two or three other new trunk roads, so rapid is the development of the country. But every year the cost of the right of way for such enterprises increases, and this element promises to prove a bar to the speedy duplication of an enterprise like the West Shore.—*Utica Herald.*

NOTES.

LENGTHS OF RAILS.—The Indianapolis *Journal* is of the impression that a new question among railroad men has sprung up regarding the most profitable and economical length for rails on the track. Up to ten years ago, a rail 16 ft. in length was in general use; then the more prominent lines began laying a 32-ft. length rail. Now, several roads are introducing a rail 60 ft. in length, and as soon as the new mill in Chicago is fairly in operation, rails 120 ft. in length are to be manufactured, and tested on one of the northwestern lines. The argument in favor of long rails is the fact that the chief wear on the rails is at the joints, which become battered usually long before the body of the rail is much worn. Then it is further argued that the wheels under the cars will wear a third longer on a 120-ft. rail, they being more worn in pounding the ends of the rails than in the actual turning of the wheels. It will be noticed, further, that with the lengthening of the rail a heavier rail is taking the place of a lighter one, but few first-class roads now laying a rail lighter than 60 pounds to the yard.

THE ENDURANCE OF WOODEN BRIDGES.

Some interesting literature was presented recently before the London and Middlesex Archæological Society, concerning "Old Fulham Bridge," in which the history of this venerable stucture was reviewed and particularized to show its almost wonderful endurance and longevity, as demonstrating that the superior character of bridges constructed of materials other than wood over the latter, is by no means an established fact, and that much must be accomplished to outwear a strong and well-built bridge of wood. The bridge referred to, which is located at London, between Putney and Fulham, is a timber structure, and the oldest existing bridge over the Thames in the metropolis, though it was erected in the year 1729, to supply an immediate and temporary want until its place could be occupied by a more permanent structure. Instead of being a comparatively ephemeral affair it has survived and done good service all these years, while two ponderous stone bridges over the Thames have become ruins, and have been supplanted by more modern structures.—*Manufacturer and Builder.*

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......Editor and Proprietor.
S. D. V. BURR.............Associate Editor.

SATURDAY, AUGUST 12, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to Geo. H. Frost.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.

COLORADO MEETING.

Programme.

Saturday, Aug. 19—In Denver. A brief preliminary evening meeting, at which the Institute will be received by the citizens of Denver.

Monday, Aug. 21—Visit to Black Hawk and Central, with an evening session at Central City.

Tuesday, Aug. 22—Georgetown. Idaho Springs. Return to Denver in the evening.

Wednesday, Aug. 23—Leadville, going over the South Park Railroad. Evening session.

Thursday, Aug. 24—Excursions to the Leadville mines.

Friday, Aug. 25—Excursions to the Leadville smelting works, reaching Pueblo at night.

Saturday, Aug. 26—Pueblo Iron and Steel Works, and Mather & Geist's Smelting Works. Colorado Springs and Manitou in the evening.

Sunday, Aug. 27—Colorado Springs and Manitou.

Monday, Aug. 28—Return to Denver. Evening reception.

Tuesday, Aug. 29—Argo Smelting Works. Golden and its smelting works. Subscription dinner.

Besides these excursions, facilities will be afforded those who desire to see the iron and coal mines of Colorado. And for those who can extend their visit, an excursion to the San Juan district will be organized.

Arrangements are being made with the railroad companies for reduced rates to members of the Institute and ladies accompanying them. When concluded, a circular will be issued informing members of the expenses from different points to Denver and return. These rates will probably not exceed two-thirds the regular rates, or about $90, plus Pullman car special rates, from New York to Denver and return. Special facilities are courteously offered by the roads in Colorado for the excursions of the Institute.

Persons proposed for membership have the same privileges as members with regard to the meeting and excursions.

As usual at the meetings of the Institute, ladies are expected to be present. Seventy-seven members with forty-three ladies have already signified their intention of being present at the Colorado Meeting, and it is expected that the attendance will greatly exceed these numbers.

The unusual attractions offered by the mining regions of Colorado are increased at this time by those of the Denver Exposition of mining appliances, minerals, etc., and by the unusual facilities offered for examining mines and works, and acquiring information concerning them.

The representatives of several foreign kindred societies are expected to be present.

Members who purpose attending this most interesting meeting should at once write the secretary of the Institute, who has to notify the railroad companies of the number of tickets required, and the names of those entitled to the special rates offered. They are also requested to inform the secretary promptly of their intention to read papers at the meeting.

Prof. W. I. Marshall, who is well known by his lectures on the wonders of the Geyser Country, offers to conduct a party of not less than eight, nor more than twenty-five, through the Yellowstone National Park. This trip would occupy from twenty-six to twenty-nine days from Denver to and through the Park and back to Denver. The greater part of this time would be spent "camping out" in the Park. The expenses of this round trip are estimated at from $275 to $300 for each person. Full information concerning this trip may be obtained from Prof. W. I. Marshall, Fitchburg, Mass.

R. P. ROTHWELL, President.
27 Park Place, New York City.
T. M. DROWN, Secretary,
Easton, Penn.

The strike of the freight handlers of the railroads leading out of this city, which began eight weeks ago and presented every appearance of being indefinitely prolonged, has suddenly come to an end, the men returning to work at the old prices. They were receiving seventeen cents for each hour's work, and struck for an advance of three cents. The companies immediately filled their places with other men, and it suddenly became known that the rapid handling of freight, with a minimum expenditure of man power, was a science not to be learned in a day. Although the new men were the physical equals of their predecessors, they lacked the "tricks of the trade," and as a consequence a double number was required. It was some time before the business of shipping by rail returned to anything like its old methods, and the consequent delays were both annoying and expensive. During the whole time of the handlers' idleness they have preserved a quiet and gentlemanly demeanor that has done much toward winning the sympathy of the public.

Death Rate at Aspinwall.—A dispatch to the National Board of Health from Dr. Nelson, formerly a member of the Board of Health at Panama, dated the 28th ult., states that the sickness and death rate at Colon-Aspinwall, are daily increasing. "Fever, as the canal officials call it, sweeps away not only laborers and strangers, but officials of the canal company as well." We quote as follows:

"As a case in point, Mr. Montel, 'sous chef,' breakfasted here on Tuesday last and died last evening (Thursday) of 'malignant fever,' so-called. (Malignant yellow fever fast enough.) The Lady Superior of the hospital there (canal) died last night. To-day the death of the Roman Catholic cure is reported, as well as the sickness with yellow fever of the Superior chief of the canal company, all in Colon, Aspinwall. Colon to-day has a population estimated at 3,500; say there are also 2,500 laborers and canal officers; this is a total of 6,000 people. They are at present dying at the rate of 100 a month—1,200 a year. If it keeps on, in five years the last individual would die. Natives in numbers are dying of fever. The ever increasing filth of the city is ascribed as the cause. New cases of small-pox appear in this city from time to time; deaths also from yellow fever among the unacclimated."

THE OUTLOOK.

During the past few weeks the market reports have shown but little change in prices, and not a brisk demand. Building operations in this city are by no means as extensive as was indicated during the opening of the season, and are mainly confined to the completion of contracts now under way; the new enterprises of such great magnitude which were promised in the spring have failed to show any signs of activity. In other sections of the country, particularly the West, building schemes are abundant, yet it seems to be a noticeable feature that the undertakings taken as a whole are confined to projects which singly do not call for a great outlay of capital; works requiring large expenditures are only found occasionally. As a consequence, the prices of building materials have decreased to their present position, and will probably show but little variation during the remainder of the season. Wages for skilled labor are not so high here, but have increased in the West, owing to the demand and lack of men.

Railroad operations continue with unabated vigor, and it is difficult to find a paper which is not chronicling the stereotyped expression "one mile of track laid each day" on some road. General railroad supplies are selling at fair prices, yet there seems to be a hesitancy, both of the buyer and seller, and inquiries are largely made for deferred delivery, until the future of the market can be more plainly seen. The statements of earnings of new roads and extensions and branches of old ones show, in a majority of cases, a traffic that will ultimately pay. How long this state of affairs will continue it is impossible to state, although, judging from the seemingly inexhaustible financial resources of the roads, the date of a cessation must be placed some distance in the future.

NEW PUBLICATIONS.

JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES.

We have received No. 8 of the first volume of this journal. The pamphlet opens with a communication addressed to "The Engineers of America," and signed by the Western Society of Engineers, the Boston Society of Civil Engineers, the Engineers' Club of St. Louis and the Civil Engineers' Club of Cleveland. Since last November these societies have been publishing their papers and transactions in common, and in regard to this arrangement state that "with the exception of some delay due to the novelty of the experiment and the inexperience of the management, which is not likely to again occur, the result has been eminently satisfactory." The address then continues:

> By this arrangement we have secured valuable results at a moderate cost; but we would ask you, shall this end here?
>
> Why should not the societies at Pittsburgh, Philadelphia and Denver, and the broader associations, namely, the American societies of Civil Engineers and of Mechanical Engineers, and the Institute of Mining Engineers and the Master Mechanics' Association, also publish with us? They could also issue separately if desired, exactly as one gets a hundred copies of his paper issued in pamphlet form in any one of these bodies. Although perhaps no man would care for the whole of any one number issued, yet the result would be a journal without equal in the world, and the engineering profession generally would be largely benefited thereby.
>
> We ask you individually to think of this matter, and if it meets your approbation, see if you cannot help to bring about so desirable a result. There are, of course, difficulties, but experience has shown that there are none which are insuperable. While what we deem a good beginning has been made, and great advantages have been derived, and we believe will continue to be derived from the present arrangement, we fully realize that much more can be accomplished than is now possible, but that it cannot be done without your aid to secure the co-operation of the engineering societies of the land.

The journal contains the following papers: "Notes on Co-ordinate Surveying," by Wm. E. McClintock of the Boston Society; "Experimental Study Comparing the Influence of Expansion in Simple and Compound Engines," read before the Industrial Society of Mulhouse by M. O. Hallauer, and translated by Charles A. Smith of the Engineer's Club of St. Louis; "The Pullman Sewerage," by Benezette Williams of the Western Society. In our issue of June 17 we publish extended extracts from this paper.

In conclusion, the proceedings of the Boston Society, at meetings held May 17 and June 21, and of the Western Society, at the meeting of June 6, are given.

THE AMERICAN INSTITUTE OF MINING ENGINEERS.

We are in receipt of the following papers read at the Harrisburg or Washington meetings: The Binding of Blast Furnaces, by S. H. Chauvenet, C. E.; Late Developments in the Siemens Direct Process, by Geo. W. Maynard; The Gold Fields of the Southern Portion of the Island of San Domingo, by Richard P. Rothwell; and The Mining Work of the United States Geological Survey, by S. F. Emmons.

THE INSTITUTION OF CIVIL ENGINEERS.

The following papers have been received: Hay and Higginson, on Bridges in New Zealand; Slagg, on The Burning of Town-Refuse at Leeds; Johnston, on The New York Elevated Railroads; Boyle, on the Rokugo River Bridge; Mansergh, on the Lancaster Water-Works Extension; Gobert, on Canal Navigation in Belgium; Cundy, on Light Scaffolding; Bender and Gaudard, on Resistance to Wind Pressure; Matheson, on Steel for Structures; and Clerk, on The Theory of the Gas Engine.

KNIGHT'S MECHANICAL DICTIONARY.

Knight's New Mechanical Dictionary. Section I. 940 pp. $2. Boston: Houghton, Mifflin & Co. 1882.

We have been using the original issue of Knight's Mechanical Dictionary for five years, and are always delighted at an opportunity of praising it. Such a fund of reliable information on mechanical and scientific topics, in such readable shape, is no where else to be found. The present issue is supplementary, and intended to cover the progress in mechanical improvements since the first issue. We find in it the same excellence of arrangement, precision and clearness which render the first volume so attractive: but the illustrations are not of the same order of merit. The publishers have not seen fit to embellish this volume with first-class wood cuts, but have introduced, instead, a mongrel selection of seven hundred and fifty-nine bad, very bad, and execrable illustrations, which, on many pages, disfigure rather than illustrate the text.

PERSONAL.

CORPS OF ENGINEERS.—Lieut. Col. Godfrey Weitzel, corps of engineers, is detailed as a member of the commission advisory to the Board of Harbor Commissioners of the city of Philadelphia, constituted in orders from the Executive Mansion, May 25, 1880, vice Col. John M. Macomb, late of the Corps of Engineers, who was retired from active service June 30, 1882. The following named officers of the Corps of Engineers will report in person, on the dates set opposite to their respective names, to Lieut, Col. Henry L. Abbott, Corps of Engineers at Willett's Point, New York harbor, for duty with the Battalion of Engineers; Second Lieut. Edward Barr, September 30, 1882; Second Lieut. Oscar T. Crosby, September 30, 1882: Second Lieut. Lansing H. Beach, October 21, 1882. Leave of absence for seven days from August 1, 1882, is granted Second Lieut. James C. Bush, 5th Artillery. Leave until November 1, 1882, is granted to Post Chaplain Robert McWatty, U. S. Army.

MAJOR-GENERAL G. K. WARREN, died at Newport. R. I., on the 8th inst. He graduated from the United States Military Academy at West Point in the Class of 1850. He was promoted Brevet Second Lieutenant of Topographical Engineers, July 1, 1850; First Lieutenant, July, 1856, and Principal Assistant Professor of Mathematics, Nov. 3, 1859. On the breaking out of the late war he was, on application of General Duryea, appointed Lieutenant Colonel of the Fifth Regiment Zouaves, and was engaged in the action of Great Bethel, and in the defences of Baltimore, assisting in constructing Fort Federal Hill. On the promotion of General Duryea, he succeeded to the command of the regiment, Aug. 31, 1861, and was promoted Captain of Engineers in the United States Army. He was engaged in the siege of Yorktown, and was placed in command of a brigade, May 24, 1862. He was at the capture of Hanover Court House, and the battle of Gaines' Mill, June 27, 1862, and was engaged in the battles of Malven Hill, July 1, and Manassas, Aug. 30, 1862. He participated, also, in the Maryland campaign, holding the centre of the line at Antietam. He was promoted Brigadier General, Sept. 26, 1862, and Major General of Volunteers, May 3, 1863. He was placed in command of the Fifth corps, March 24, 1864, and was at the siege of Petersburg, June, 18, 1864. He was promoted Major of Corps of Engineers, June 25, 1864; was breveted Brigadier General U. S. A., for gallant and meritorious services in the field during the rebellion, and was engaged in the battle of Five Forks, the last battle of the war, when the unfortunate misunderstanding, which deprived him of his command, took place between Lieutenant General Sheridan and himself. General Warren was the first officer ever assigned from the West Point Military Academy to a volunteer regiment.

DOUBLING ITS LINE TO MANITOBA.—A dispatch says that the St. Paul, Minneapolis & Manitoba Company has a party of surveyors in the field surveying a line from Morris, Manitoba, and Pembina. This new route will run direct from Winnipeg to Pembina, thence south, and will connect with the main line running north from Grand Forks, and now about completed to Hamilton, in Pembina County. The route when completed will give the St. Paul, Minneapolis & Manitoba two direct lines into Winnipeg from St. Paul. Bonuses of $150,000 have been subscribed by citizens along the proposed line.

TESTING AND TESTING MACHINES.

THEODORE COOPER.

The increasing demand for new and more practical information in regard to the strength of our materials of construction, is a sufficient indication that the numerous tests heretofore made, are far from satisfying our wants.

As an effort is now being made to have a more careful and extensive series of experiments made upon our structural material, to at least partially satisfy this demand, it is desirable for all interested in the use of the metals, either as designers, manufacturers or users, to outline beforehand what information is most desired; and to advance such facts as may be of assistance in reaching the desired end in the most direct and economical manner.

Small Specimens.—The great mass of tests heretofore made have been upon test-bars or specimens. Sometimes these specimen bars have been actually cut out of the larger pieces, of which the strength was sought. But frequently they were formed by drawing down the large pieces under rolls or hammers, or, by making special casts of a small size; it was, of course assumed or intended that such specimens would represent relatively the strength of the larger pieces. Too often the only result sought even upon such specimens was the breaking strain. The results and conclusions drawn were contradictory, confusing and unreliable. It is not strange, therefore, that the general opinion in regard to the strength and capabilities of our materials has been full of erroneous conceptions.

When the *test strength* of the same material can be made to vary as much as 50 per cent., by giving the specimens different forms, by different methods of testing, and by variations in the manner of measuring the strains, without considering that too often the specimens were specially selected to advocate particular interests, the value that should be given to the great mass of these experiments is very small. To experiments giving the breaking strain only, omitting all mention of the shape and size of specimen or manner of preparing the specimens, and without reliable data giving the ductility of the material under the breaking strain, the expert would give *no value.*

So much time, material and money have been expended uselessly in making tests of the character above mentioned, it is now generally recognized as desirable that all specimen tests be made upon a uniform standard size and shape, and that not only the breaking strains be recorded, but also the elongation of the specimen over a fixed distance, and the contraction of area at the broken section, as well as all other data in regard to the manner of testing and preparation of the specimens. By thus eliminating the variations due to the different forms and sizes of specimens, we get, by an examination of the breaking strain and ductility, a *comparative* value for the material under examination.

The idea that specimens taken from large masses of material represent relatively the strength of the larger pieces is not now so prevalent as formerly, but still lingers in the minds of too many, even of the engineering profession.

If a forged, cast or rolled piece of iron or steel were subdivided into numerous small specimens, and the strength of each specimen determined, we could not then, unguided by a knowledge of its mode of manufacture, be assured that the strength of the original mass would be as great, relatively, even as the *weakest specimens* cut from it. The individual specimens may be comparatively free from any internal strains, while the original mass may have been near the rupturing point in some section from internal strains due to the method of manufacture.

Below I give the results of tests made upon some of the large steel anchor bolts made for the St. Louis bridge, which ruptured while being subjected to the standard working test of 40,000 lbs. per square inch. As the breaking of these bolts was a surprise to those interested, samples were cut from each of them and tested to see if it was the fault of the quality of the material. It will be seen that *all* the samples were from *three* to *eight* times as strong, relatively, as the original bolts.

SOME TESTS OF STEEL ANCHOR BOLTS FOR ST. LOUIS BRIDGE, AND TESTS UPON SAMPLES CUT FROM THE SAME BROKEN BOLTS.

Length of bolt, feet and inches.	Diameter of bolt, inches.	Breaking strain, lbs. per square inch.	Specimens from same broken bolts, lbs. per square inch	
34 ft. 5 in.	5.75	30,000	101,000 100,000	
33 " 1 "	5.75	33,000	170,000 118,200	
31 " 11 "	5.87	28,000	130,000 122,000	
32 " 0 "	5.86	10,400	No. 1, 110,000 3, 114,500 5, 115,500	Specimens left as cut from anchor bolts.
This last bolt was an annealed bolt.			2, 78,500 4, 81,000 6, 92,500	Specimens annealed after being cut from bolt.

The samples 1 to 6 were cut from the broken end and numbered as follows, and every other one annealed.

The above tests were made upon some of the first of these bolts that were forged.

Those made at a later period proved very satisfactory, and stood the standard test of 40,000 lbs. per square inch without any permanent set.

The specimens taken from the successful bolts do not differ in general results from those cut from the defective bolts.

The difference was largely due to greater care in the processes of manufacture.

The testing of every piece of a structure, or a proportion of them, up to a specified limit within the elastic limit, is a very desirable operation as a check upon the mode of manufacture, but unfortunately it takes time and money.

STRENGTH OF LARGE MASSES, OR FULL-SIZED PRACTICAL FORMS.

In general terms the strength of all forms of the metals is dependent upon numerous factors, which may be classified into those due to characteristics of the crude metal, and those due to the work performed upon the crude metal. (The term crude metal being used relatively; for instance, what would be crude metal to the bridge manufacturer would be finished metal to the rolling mill, and what would be crude metal to the rolling-mill would be finished material to the puddler; and the crude material of the puddler would be the finished product of the blast furnace.)

Every kind of work put upon a piece of iron or steel produces changes in the characteristics of the material—whether it be by hot working under rolls or hammers, wire drawing, cold working, stretching in a testing machine to points beyond the elastic limit, annealing, bending, punching, etc.

The work may be beneficial or injurious according to the particular character of the work and dependent upon the purpose to which the finished product is to be applied.

The character of the ingot metal, amount of reduction in the rolls, size of the rolls, number of passes, number and condition of the heats, etc., all influence the characteristics of the finished metal.

In built structures like girders and columns we have not only the variations in the rolled sections from which they are formed, according to the particular rolling mill processes and the kind of iron used by the mill; but we have the additional variations due to the processes of punching, straightening, riveting, etc., in the building of the piece.

In making tests of large masses of metal or of built structures, we are liable from the variations in characteristics of the crude material and in the several processes of manufacture to obtain apparently contradictory results, and to be confused as to any law governing their proportions.

Any tests made upon such masses or built structures, should, as far as is practicable, be accompanied by a detailed history of the processes through which they have passed, and also be accompanied by tests made upon the crude material used in their formation.

Where a series of any kind of structures is to be tested, as beams or columns of varying dimensions, they should all be put through the same processes and be made by the same establishment from one kind of crude material. The law dependent upon their proportions might then be determined with more certainty. Comparison of different series of other material and other manufacturers would then give us a knowledge of the variations due to different crude materials and different processes of manufacture.

Too much stress has heretofore been laid upon the breaking strength of our materials of construction to the neglect of other data of great importance.

In many classes of our structures it is of vastly greater importance to be able to so proportion them that they can be subject to certain repeated and prolonged applications of loadings without breaking, than to know that they will break under a single application of a load we have no intention of applying.

The laws governing the shapes and proportions of any structure, which is to give the best results under a rupturing strain, are entirely different from those governing the proportions and shapes, when the structure is to be subjected to certain limited strains only, especially when these limiting strains are intended to be so restricted that no permanent distortion is to take place in any part or member of the structure.

In one case, the ductility of the material enters as a most important factor; while in the other, it does not occur at all, as the ductility or flow of the metal does not commence until the elastic limit is exceeded, or permanent distortion takes place.

The preference to be given to the two methods must be determined by the special circumstances of each design.

In the excellent report upon iron for chain cables of the U. S. Board to test iron and steel, we find the following remark: "Our experiments have been all so carried out that while we have been able to obtain data both as to the mechanical and physical properties of wrought iron, and as to the effect of different methods of treatment of the raw material, all have been made to contribute their quota toward the establishment of methods by which an iron could be judged correctly, as to its *adaptability for chain cable manufacture. Such points* well established would prove to possess value not only to the manufacturers and purchasers of cable and cable iron, but not less to the manufacturers of iron bridges and other constructions, which, *like the cable*, depend for their value upon their power of *resisting, to the utmost, destroying forces* of various and irregular natures" (italics our own).

The first paragraph of the above quotation has our hearty indorsement, but to the second we must take decided opposition.

Chain cables and bridges are two entirely distinct classes of structures, and must be proportioned and judged by distinctly different properties of the material from which they are made.

The only consideration to be given to the element ductility in structures where the strains are kept within the elastic limit, is the influence i may have upon the processes of manufacture. This is a very important consideration, but, nevertheless, it does not effect the *proportions* of the structure.

Much false doctrine and many erroneous conclusions have been drawn from the indefiniteness of the term "strength of materials," and a reliance upon the breaking strain, as determined by testing under a steadily increasing load up to the rupturing point.

The harm would have been far greater had not the experience of practical men contradicted the conclusions drawn from such tests.

And to such experience is due the credit of the advances made in designing and proportioning the great mass of our structures.

Iron which gave high results in the testing machine, experience proved to be most unsuitable for practical purposes.

Forms which gave high test results were found practically to be weak ones.

The difference in the conclusions was due to the different character of strains to which the material was subjected, under the test and under practical use.

That measured by the testing machine being simply a *statical force*, while in almost every practical application of our materials of construction we must resist dynamic energies.

The question to be solved, therefore, is not the statical resistance of a piece of metal, but what *duty* can it perform under certain circumstances.

To determine the best manner of shaping and proportioning our materials to obtain from them the best duty, it is necessary to experiment with them under such strains as occur in actual practice—strains which vary between wide limits, from a purely statical one to the most violent due to explosive components, some being unvarying in character while others are constantly changing between wide limits.

Could we afford the time and money to make *endurance* tests upon each kind and form of structure, our knowledge of the capabilities of our materials would be vastly increased. It is desirable that sufficient of these endurance tests be made under known circumstances to enable us to determine many doubtful points in regard to the influences affecting the duty that can be obtained from our materials.

On considering the great variety of purposes to which we apply the metals, we find the different structures can be divided, *comparatively*, into two general classes, perishable and permanent structures.

The first class, comprising all those which are limited in their life by their loss of material through use or oxidation and by the deterioration of the metal through the action of the strains upon their peculiar forms—such as boilers, rails, rolling stock, cannon, chain cables, etc. The second class, those which are intended to last an indefinite time, as bridges, roofs, certain classes of machinery, etc. Now, the amount of work that can be performed by any structure up to the rupturing point is proportionate to the breaking strain into the ultimate elongation of the piece; and this is usually considered to be a measure of the ability of the piece to resist dynamic energies. This is probably true within *certain limits of time or velocity*.

The development of the ductility or flow of the metal requires time. If the velocity of the force to be resisted exceeds the velocity of flow of the metal, the bar will rupture without flow. This is shown by the difference in the fracture of even a ductile metal, by slow or sudden strains.

Different metals which give the same rupturing strain and equal ductility under the ordinary testing machine test will show different results when subject to impact and punching tests. If the users of steel plates would experiment upon a decreased velocity in their punching machines, so the metal would have more time to flow, they would probably find the effects of punching much less injurious to the steel. A set of steel plate tests made under the ordinary punch and a set under the slow-moving hand punch would be interesting as illustrating this point.

The amount of work that can be performed by any structure up to the working or elastic limit is entirely independent of the ductility and is proportionate to the working or elastic strain into the elastic elongation due to such strain.

As this work measures the "duty" of our permanent structures, it is very important for us to know to what extent we can depend upon the elasticity of our materials of construction under the varying circumstances to which they are liable. Does the elastic limit vary with different methods of straining the piece? Does the velocity with which the force is aplied, effect the position of the elastic limit? Is there an approximate point considered from the zero of strain which marks the elastic limit, or is it determined by an Elastic Range measured from any initial strain (at which the material may have had time to take on a new state of equilibrium)? For example, if a piece of metal (which would show a limit of elasticity of 20,000 pounds, under the ordinary tests from zero up to 20,000 pounds) were loaded to 10,000 pounds and allowed time to accommodate its molecules to this condition, would it show an elastic limit only up to 20,000, or would it not go to 30,000.

Again would the same metal which would show a limit of 20,000 lbs. under tension or under compression continue perfectly elastic, if the strains were continuously reversed between plus and minus 20,000, making the range of elasticity 40,000? or would the limit then fall down to near + and — 10,000?

From the results of the experiments of Wobler the writer is inclined to the belief in an elastic range to be measured from any initial condition of the metal, rather than a simple elastic limit measured in all cases from the zero of strain.

A complete knowledge of the characteristics of the metals under different kinds of strains within the elastic range, combined with endurance tests upon each class of structure, must be the true basis upon which to design and proportion nearly all our structures.

Upon such a scientific foundation we can hope to so build as to increase the life of all our so-called perishable structures and to remove some of them possibly into the class of permanent structures.

The life or duty of nearly all our perishable structures is much more dependent upon their elastic qualities than their ultimate resistances of strain and extension.

The ability of many parts of machinery to resist the occasional strains to which they are liable from accidental causes, does not determine their life as generally as their ability to meet without permanent change of form the less severe but more constant forces due to their regular work.

The forms given to the rapidly-vibrating connecting rod of the locomotive, the form of a railroad axle, etc., as derived from the endurance tests of actual experience, all tend toward making them more uniformly elastic under the peculiar strains to which they are liable.

The Testing Machine.—When all the erroneous ideas and false conclusions due to the past use of the statical testing machine are considered, it is very questionable if the injury to the art of construction has not far exceeded the benefits.

The greatest advances made in our knowledge of construction have been due rather to the comparatively fine experimental endurance tests that have been made and to the results of the endurance tests of actual experience, than to the information obtained by means of this machine.

In its proper sphere it has an immense field of useful research. This sphere, in the writer's opinion, is the analysing or resolving the elements of the endurance of any structure or material under different classes of strains.

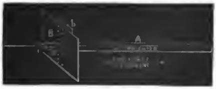
Alone it is no more capable of determining the ability of our materials to resist the dynamic energies to which they are subjected in actual practice than the steel-yards are to measure the possible effect of a steam-hammer or pile-driver.

To interpret the results of endurance tests properly, it is necessary that the elements governing great endurance be analyzed and determined, including not only the statical resistance of the material, but the effect of form, number of applications, duration and the effects of velocity.

We then will be in a better condition to predicate the duty that may be expected from certain classes of material in particular forms.

NEW CURRENT METER.

Besides engineers, owners of sites on mill streams and many others frequently desire to find the velocity of a stream. Few, even of professional men, care to purchase expensive current meters, and few others than professionals could, if they had them, make the experiments and calculations.



The above instrument or contrivance indicates both the pressure and velocity. It is not only the simplest and cheapest, but ought to be more accurate than any other, as *there is no friction of the parts*, to be guessed at or calculated, as in all other current meters or current gauges of which I have any knowledge, and also in all anemometers that I have met (anemometers are sometimes used as current meters); but whether it really *is* more accurate than others I cannot say, never having used anything else except floaters, which I have found *thoroughly unreliable*—if I may so express it.[*] It can be made by any one, anywhere, at little or no expense. I have used it on two rivers, the Danube and the Rhone, to measure velocities preparatory to placing current motors, and always found the pressure and velocity indicated to be closely corroborated in the power yielded by the motor.

A is of hard wood, 1 in. square and 5 ft. long, and may be in several sections for convenience in packing. *B* is of tin, 6×6 in., but may be of thin wood. The strip *b*, which extends across *B*, and is penetrated by the tenon *a*, is of light dry wood, 1 in. thick and about 2 in. wide (or just wide enough to give sufficient buoyancy to prevent *B* from sinking). Strips of lead (other metal would do) are tacked at the centre of *A*, till it is of about the same specific gravity as water. (Lay it in still water and add all the lead it will bear without sinking.) If no sheet lead is obtainable, flatten out large shot or bullets and tack them on, or drive them into holes bored in the wood. Thus having in the water neither weight nor buoyancy, the current holds *A* horizontal and *A* holds *B* vertical. (*B* being barely submerged, the greatest possible vertical oscillation of *A* would be but 3 in., as 3 in. would bring its rear end to the surface.) *A* being 5 ft. long, a 3 in. oscillation would throw *B* only about 2 deg. from the vertical. *c* is a string loop; *d* a cord, say 5 ft. long, attached to a common spring balance. The balance should be well oiled to prevent rust, and held, say six inches, below the surface; but if, on account of the water not being clear, it has to be held above the surface, then the string should be 20 to 50 ft. long to bring it nearly horizontal, and sufficient lead washers must be slipped on to the tenon, *a*, to keep *B* submerged.

As the pressure of the current is not uniform, the least and greatest pressure within, say three minutes, should be noted and the average taken. The larger the plate *B* the more uniform will be the pressure, but the length and cross section of the vane *A* must be increased proportionately with *B*. Yet I have obtained fair measurements with *an instrument which would go in the vest pocket*, *B* being 1 in. square, and *A* being in sections, with a total length of 10 in. I used the 8 oz. counting-house spring balance.

If one uses a scale or balance whose hand will "set," it may be attached to a pole and measurements taken far below the surface.

Some would suggest to thicken the tail end of *A*, but this would cause an additional "pull" on the cord *d*, which it would be necessary to calculate.

There will be a slight oscillation of the vane which will cause the plate *B* to deviate very slightly from the vertical. This deviation, although too slight to be seen, would cause the indicated pressure to be a trifle less than the real force of the current, were it not for the pressure received by the vane itself, which we have always assumed, when the vane is of the length prescribed, to balance the loss by deviation from the vertical.

The actual pressure on the vane is easily ascertained. Suppose we have a pressure of 36 oz. on the plate *B*—1 oz. to the square inch. Detach the plate and note the pull of *A* alone (using an 8 oz. spring balance). Say it is 1¼ oz. We deduct 1 oz. for pressure received by the front end of *A* (it having 1 square inch area of cross section), which leaves ¼ oz. as the pressure upon *A* resulting from the friction of the water against it.

Some would suppose that if a cord ran from each corner of the plate to the spring balance, or to a common center, the measurements could be taken without *A*, but in such a case the plate does not remain at right angles to the current, but dodges about in all directions. Now if any support be arranged to prevent this bobbing around, there will be friction on the part in contact with that support.

Having the pressure, we get the velocity by Hutton's rule—the pressure in pounds per square foot equals the square of the velocity in feet per second; or, to put it in simpler form, that the uneducated may understand it: Having the number of pounds pressure (say 16 lbs.) against a board or plate 1 ft. square, find what number multiplied by itself would produce 16. That number is 4—the velocity in feet per second; 4 ft. per second equals 240 ft. per minute, equals 14,400 ft. ($2\frac{1}{5}$ miles) per hour. The plate *B* being one fourth of a square foot, 4 lbs. on it would, of course, indicate 16 lbs. per square foot.

S. N. STEWART,
Philadelphia.

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[*] I am aware that many favor floats, and that General Humphreys and Captain Abbot U. S. Army, relied upon floats in their extensive Mississippi measurements. Just before the battle of Agincourt a messenger said to the Constable of France, "My Lord, the English lie within 1,500 yards of your tents." The Constable replied, "Who measured the ground?" So I would ask Messrs. Humphrey and Abbot and the admirers of their method—who measured the line of march of the float as it moved between two points marked upon shore? A float not only travels faster than the current (sliding down hill constantly, but the hill it slides upon also moves), but the current does not move in a straight line. "There are no straight lines in nature." *A float not only deviates to the right and left*—although it may not seem so seen from shore—but, unless the water is perfectly placid, it moves up and down, over waves or ripples, up hill and down dale.

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THE MAGNAGHI FLOATING COMPASS.

The floating compass, invented by Captain Magnaghi, is now in use on board the Duilio, and will probably be generally adopted in the Italian navy. Its main feature, says *Engineering*, is the suspension of the needle in water, to which has been added one tenth its volume of alcohol, contained in a vessel with a perforated bottom, which allows the liquid to rest ultimately on an elastic diaphragm. The addition of the alcohol prevents the water from freezing under low temperatures; and the elastic diaphragm allows it to expand and contract during atmospheric changes, without danger of breaking the glass which covers it, or admitting air. On this liquid the needle floats, enclosed in a hermetically sealed ellipsoidal case, which is very delicately suspended upon a conical brass pivot. The pivot has a sapphire top and a jade point, and the friction is diminished to the utmost possible degree by the most perfect polish. The needle usually consists of six bundles, each made up of five pieces of the best ribbon steel, thoroughly tempered before being magnetized, and separately tested after. These pieces are kept apart by strips of cardboard soaked in oil, and their number can be increased if necessary. Wherever in the apparatus two metal surfaces or edges meet, friction is prevented, and closure secured, by a layer of blotting paper soaked in mineral wax. This is exclusively used for the purpose, because it is insoluble in alcohol; and even the marks and figures in the outside ring are rendered distinct by being filled in with the same substance blackened. All the interior parts of the instrument are silvered, in order to prevent oxidation and galvanic action between the various metals composing it, and to keep the fluid perfectly colorless and transparent. The compass proper (including the floating case with the needles) weighs in the air about 750 grammes; but in the liquid it exercises a pressure of only about 6 grammes on the point of support. The chief advantage claimed for this invention is that the resistance of water being great toward rapid movements and inconsiderable toward slight ones, it leaves the motions of the needle practically free, while shielding it (by its own incompressibility) from all shocks from without. The compasses of the Duilio were not in the least agitated by the discharge of the 100-ton gun, nor by the motion of the screw, although the supports on which they were placed were in such a position as to feel the vibration greatly. They were somewhat disturbed by the rolling and pitching of the vessel; and to meet this difficulty, modifications were made in the shape and arrangement of the different parts, so as to render the floating case thoroughly centrifugal, distribute great portion of the weight round the circumference, and fix the point of suspension very little above the center of gravity. The result of these arrangements is, that when the compass is tilted by the movement of the ship, the needle is so slow to change its position, that before it has again become horizontal the motion is reversed, and the inclination counteracted. The needle is also very little affected by changes in the angle at which the terrestrial magnetic current is inclined to the horizon, which varies in different localities, in consequence of the needles being so much shorter than the diameter of the compass, and being placed too low with regard to the point of suspension. This is proved by the simple test of holding a powerful magnet directly over the north point of the compass, when even this great increase to the vertical force produces only a very slight change in the inclination of the needle. The compass is fitted with a special sextant, in which various improvements have been introduced, to increase the facility and accuracy with which observations can be taken, especially in twilight and cloudy weather.

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THE LIVERPOOL OVERHEAD RAILWAY.

The overhead railway along the line of docks at Liverpool, which has just received the sanction of both houses of parliament, is an undertaking of a novel and unique character in railway construction so far as this country is concerned, although in New York a railway on a similar principle has for some time past been in active operation. The Liverpool docks, as is pretty generally known, stretch along the frontage of the river Mersey, to the length of upwards of seven miles, from north to south, and the intended railway will run parallel with the dock, on a high level above the ground line to the entire length. The line, which will be constructed almost entirely on the Mersey dock board's property, will commence near the northern boundary of the board's Liverpool estate, in the adjoining borough of Bootle, and terminate at the Herculaneum dock (which is the extreme south boundary of the dock board's system) in the parish of Toxteth Park. There will thus be railway communication between the two densely populated localities at the extreme north and south ends of Liverpool, as well as stations at different points within those portions of the city of Liverpool itself immediately contiguous to the line of docks. The line will be carried chiefly on piers and columns at an elevation of from fifteen to twenty feet above the roadway, and will pass over several thoroughfares leading from the interior of the city to the river. The railway, which is to be constructed as a double line throughout, is to cost £656,000 for construction only, no purchase of land or compensation being required. Passengers only are to be carried, the railway not being in any sense a goods line.—*Herapath's Railway Journal.*

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THE WATER-SOFTENING PROCESS.

The important question of the softening and purifying of hard water in bulk has received a satisfactory solution in the Atkins process, which promises to be of great public service in these respects. This process is a modification of and an improvement upon the old Clark system of softening water, which consisted in adding lime to the water to be softened, and allowing the mixture to stand for 24 hours in large reservoirs or precipitating tanks before it could be used. In the Atkins process, however, the precipitating tanks are dispensed with and the water can be used as it is softened, the process being continuous and no time being required for it to stand and settle. The process essentially consists in chemically purifying the water instead of mechanically as in ordinary filtration. In practice a small jet of lime water is introduced into a portion of the water to be softened, and the two are blended in a mixer, whence they flow into a softening tank into which the bulk of the water is conducted. From this tank the water with the lime in suspension flows into Atkins rotary disk filters, in which the solid particles are all arrested by an ingenious system of cloth-covered disks placed within a tank, and which present a very large area for filtration within a very small compass. The purified and softened water is conducted from the filters to storage reservoirs ready for use. The effect of the lime water is not only to purify and soften the water in bulk, but to cause any clayey matters that may be held in suspension to coagulate, thus facilitating their removal. The water passes from the outside to the inside of the filters through the cloth-covered disks, the surfaces of which become in time coated with a deposit consisting of carbonate of lime and impurities. These surfaces are quickly cleaned by means of a series of brushes which are brought into contact with the disks. The brushes, which are fixed on a spindle, are rapidly revolved as are also the disks, but in opposite directions, the result being that in a few minutes the filters are cleansed and ready for work again. The system has been successfully applied to private water supplies in several instance , notably at the residence of the Duke of Richmond at Goodwood, and at that of Mr. W. H. Smith, member of Parliament, near Henley. The first application of the system to a public water supply is that of the Henley-on-Thames water-works, which were recently opened. It was introduced there by the engineer to the water company, Mr. Jabez Church, in consequence of the extreme hardness of the water, which is obtained from the chalk, and is normally of about 19° of hardness. After treatment, however, by the Atkins process the hardness is reduced to nearly 4°, which means a beautifully soft water. The apparatus is calculated to soften and purify rather more than 100,000 gallons of water per working day of 10 hours. The softening apparatus was supplied by the Atkins Water-Softening and Purifying Company, of No. 62 Fleet street, London. The system has been tested on the London & Brighton Railway by Mr. Stroudley, the locomotive superintendent, who is having an apparatus put up to soften and purify between 300,000 and 400,000 gallons of water per day for the supply to the boilers at the company's locomotive and carriage works at Brighton. The practical value of the system is, therefore, established as regards the treatment of waters containing carbonate of lime.—*London Times.*

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NORTHERN PACIFIC.

LAKE PEN D'OREILLE (I. T.),
July 26, 1882.

Very few readers of the *Chronicle* are aware of the rapid progress being made by the builders of the Northern Pacific Railroad on the Pacific slope. So little is said either by telegraph or by the letters of correspondants relative to the Northern Pacific that very few are able to obtain a clear understanding of the railroad situation in the far North. I write this letter at the extreme northern point of Pen d'Oreille lake, about 40 miles from the British line, and 459 miles northeast of Portland, Or., yet I am nearly 50 miles behind the graders who are laying the track eastward. It is difficult to realize how a railroad has been built through these deep gorges and canyons, over bluffs, across miles of lakes, through dense forests, because so little is said about it. The line has been built through Washington Territory, across Idaho, and is now being pushed southeastward as fast as 7,000 men can grade and lay track.

A BEAUTIFUL LAKE.

To better understand the railroad situation in this region, the reader should refer to a map of the northwest. It will be seen that in northern Idaho there are three large lakes, the Cœur d'Alene, the Pen d'Oreille and the Kaniksu, the last being very close to the extreme northern boundary of the United States. Of these three lakes Pen d'Oreille, or, as the people here pronounce it, "Ponduray," is the largest and most beautiful. It is a sheet of water more than sixty miles in length, varying in width from one and a half to four or five miles, and deep enough to float the largest vessel that enters San Francisco Bay. Its surroundings are very beautiful. On all sides the pine-clad mountains loom up. Here and there upon the summits, exposed to the north winds, the snow is seen all the year round, forming a sharp contrast to the inky-black forests which reach from the banks of the lake to the very highest point of the mountains. Tourists rave about the grand scenery of the lower Columbia, the Yosemite, the Grand canyon of the Arkansas, or the gorges of Colorado. Here may be seen wild landscapes, blending all the grandeur and beauty of the above named resorts in one superb whole. It was nearly sunset on the fourth day out from San Francisco when the train suddenly emerged from a long stretch of forest, and crept slowly over a trestle-work one mile and a quarter long, which spans a narrow strait or channel connecting the upper and lower lakes. The scene which presented itself was too beautiful for description. The grandeur of the surroundings must be seen to be fully realized. These immense pine forests of the extreme north are grand and gloomy enough near the coast; but up here, where they extend to the sky, and are blended with lakes, cascades, canyons, and a confused mass of illimitable mountain scenery, they are grand indeed.

SUPPLIES FROM SAN FRANCISCO.

The Northern Pacific has been built around the northern end of Pen d'Oreille lake, the track just elevated enough to be above danger from high water. The bridges seem to be numberless, and trestle work forms a large proportion of the line for nearly twenty miles around the lake. At Pack River, where the stream enters the lake, there is another bridge one mile in length, over which the line passes. Here at Pack River I noticed something worth special mention. Merchandise from San Francisco direct was being unloaded from cars and packed upon the backs of mules, to be taken to British Territory, which is less than fifty miles away. Inquiry developed the fact that this merchandise, consisting of flour, bacon, sugar, coffee, clothing, picks, shovels, powder and sutler's stores was being shipped to the working parties on the Canadian Pacific Railroad. Some of the Packers stated that the Canadian Pacific road is being graded as fast as men can do the work, and that several sections were being constructed eastward and westward simultaneously. This depot of supplies in the mountainous backwoods of Northern Idaho is the nearest and best the Canadian people have found east of the coast.

DIFFICULT RAILROAD WORK.

Near this point the Northern Pacific turns from the lake shore and continues its southeasterly course towards Missoula. It might be well to remark, by way of explanation, that Lake Pen d'Oreille is, in fact, a part of the Columbia River. Clark's Fork of the Columbia enters the lake near the Montana line, and leaves it again near its northern end. The lake is re-enforced by numberless small streams, which empty into it from the adjacent mountains. The work now being done along Clark's Fork of the Columbia is of the heaviest and most difficult character; hence the progress is comparatively slow. To illustrate the character of the work along Clark's Fork of the Columbia in Montana, a cut has been made near Cabinet landing, 800 ft., center height 16 to 28 ft., and averaging 22 ft., and containing more than 24,000 cubic yards of rock, earth and bowlders. This was cut in fifty days by means of giant powder, drills and steam-power.

AMONG THE ROAD-BUILDERS.

From the time one leaves the lake and enters the pass or valley of Clark's fork, one begins to see something of the active work going on at the front. For more than twenty miles workmen are seen digging, chopping, blasting, lifting, cursing and shouting. Trees are crashing down, earth is flying from countless shovels, and huge rocks are being riven and scattered on all sides. As the construction train moves slowly forward, the observer begins to realize some of the difficulties of railroad building in the Northwest. This is about the way it is done: The line having been laid, surveyed and staked, parties of white men, hundreds in a gang, proceed to mow down the forest. The trees are felled with surprising rapidity—it might be said that they are mowed down—and a broad swath, 200 feet wide, is opened up through the forest. The trees are immediately trimmed and cut into lengths and rolled out of the way, when other gangs attack these logs and split them into ties. Now comes another party of white men, who proceed to dig about the roots of the fallen trees; a keg (sometimes two) of powder is placed under the tree stump, a fuse attached, earth thrown about it and tamped down, a light attached to the fuse, and the stump is blown up. The white men pass on, and now come the Chinamen—thousands of them. They proceed under the direction of white bosses, or "herders," as they are called, to level the earth, throw up a roadbed, carry ties from a construction train, or from teams close by, and lay them in place. Other gangs of Chinamen carry steel rails, and white men proceed to lay them and spike them. The supply train slowly moves forward as the track is laid, and other gangs of Chinamen follow on a gravel train and finish the new-laid track. Thus the new railroad is being built toward the Mississippi river at St. Paul.

SCENES AT THE FRONT.

At present only little more than half the distance usually built in clear ground is completed daily. During July twenty-eight miles will be completed. This brings the Northern Pacific (Western Division) to Rock Island, on Clark's fork of the Columbia, 497 miles northeast of Portland, or about 500 miles from the mouth of the Columbia River. On the 1st of August another section of fifty miles will be officially offered for government inspection, and daily passenger trains will begin to run over the newly built section. Near the end of the track may be seen the largest moving city in the world. Never during the present era of railroad building has there been witnessed such a scene as this which now presents itself at the end of the track. Here are at least five thousand persons, all men, except, perhaps, twenty-five, and all bent on making money. There are tents, shanties, caves and "wickyups" of all shapes and sizes. Order or regulation so far as streets are concerned there are none. The valley is too narrow for a compact town site for five thousand inhabitants, hence the tents and shanties are scattered. I counted fifty-one gin-mills, or saloons, a dozen general merchandise tents and shanties and about the same number of boarding tents.

A ROUGH FRONTIER ARMY.

Superintendent of Construction J. L. Hallett reports about 7,700 men employed. Of these about 6,000 are Chinese and 1,700 are white men. Mr. Hallett is prepared to give work to all the white men who desire employment and is preparing to increase the working force at the end of the track to 10,000 men. Think of it! Here is a small army, which is to be fed, kept at work and managed, yet Mr. Hallett succeeds in keeping the scattered thousands all employed, well fed and properly regulated. It is very doubtful whether so large a crowd of rough men, unrestrained by law, were ever so well controlled as these. A wilder or rougher lot of people never assembled at one place on the frontier. There are men of all colors, all nationalities, and refugees from every penal colony in the world. The Chinese are mostly newly imported coolies. They live in tents furnished by the company, and live in gangs of from 50 to 100 under a white herder, who receives from $75 to $90 per month for his services. A more thankless or difficult task can scarcely be conceived of than this of the "coolie herder." He is expected to keep his Chinamen at work: if he fails he is removed by the Superintendent. He finds it impossible to urge or hurry his Mongolian charges. They dig, talk, chatter, laugh and loaf. There is no hurry about a Chinese laborer. He just keeps moving—that's all. When a live, active white man is placed in charge of a gang he attempts to hurry the Mongolians. They usually stand this crowding or hurrying business one day. Next day the gang strikes work. The Superintendent or section boss is sent for, who asks: "What's the matter, boys; why don't you go to work?"

Then the spokesman of the gang meekly and smilingly replies: "Boss no good; we no sabbee boss; we no sabbee boss."

That settles it. A new boss is substituted before the coolies will "sabbee" enough to go to work. Hence, it can be seen who is boss at this neck of woods. Chinamen are hard to get, and they have to be handled gently.

A FUTURE MOUNTAIN METROPOLIS.

Thirty-five miles east of the present end of the track is Thompson's Falls, to which point the road will be completed early in September, leaving just 100 miles to build to Missoula, M. T., the future big town in the North. The graders and working parties are now pushing on ahead of the track and scattering themselves along where heavy cuts are to be made, but as these are very few beyond Rock Island progress will be much more rapid than heretofore. East of Missoula a division of the road has been let out by contract to the Mormons, who are now at work several hundred strong building both ways east and west. Yesterday, while at Sandy Point, near the head of the lake, I witnessed the launching of a handsome little side-wheel steamer to be called the Missoula. This boat is intended to run on Clark's fork of the Columbia between the end of the track at Rock Island and Thompson's Falls, carrying freight, railroad stores, etc. It is the property of Captain David McKinney, an old locomotive engineer from California. The boat is 42 feet long and is light enough to be hauled around the falls and relaunched on the river when the road reaches the present head of navigation.

WORK THAT HAS BEEN DONE.

To give some intelligible idea of the railroad situation in the North, I will repeat the statement made to me the other day by John Muir, Superintendent of Traffic on the Northern Pacific Railroad. Completed between St. Paul, Minn., and Forsyth, M. T., 816 miles; completed between Portland and Rock Island, M. T., 497 miles; complete boat and railroad connection to Thompson's Falls, 438 miles east of Portland. On Aug. 1 a daily line of four-horse stages will commence running between the end of the track and Missoula, where connection will be made with two lines of Gilmer, Salisbury & Co.'s stages for the end of the Utah Northern Railroad, 130 miles south, and to the Bozeman division of the Northern Pacific, via Helena, at Forsyth station. There is now a gap of 624 miles to build, over an open country, and this gap is being rapidly closed up at the rate of nearly four miles a day, as men are working at both ends, and in the center both ways from near Missoula. The present time from St Paul, Minn., to Helena, is four and a half days. On the first of October of this year the passenger time between Chicago and Portland will be eight days, or a little less than the present traveling time between the two cities via San Francisco. The entire line from Chicago via St. Paul, Helena, Pen d'Oreille, Portland to Seattle will be completed early in 1883. This line will traverse some of the most attractive sections of the American continent, including the Lake Park region of Minnesota, the wheat belt of Dakota, Pyramid Park, Red River valley, the great National Park of the Yellowstone, the Flathead Indian reservation, the Pen d'Oreille lake region and the Columbia River, via the Cascades and the Dalles.

INDUCEMENT TO TOURISTS.

At present the country in the immediate vicinity of Pen d'Oreille Lake is unsettled, its only inhabitants being a tribe of miserable Indians, who live by fishing and hunting, and a few people scattered along the railroad. These mountains are densely covered with valuable timber, including pine, fir and cedar. The cedar is very large, and will prove very valuable. A marble vein or ledge has recently been discovered near here, said to be equal to Italian marble. It is from twelve to twenty feet thick. The locator of the claim sold the marble vein for $10,000 last week. It is said that good indications of gold and silver have been seen in the adjacent mountains, and prospectors are out looking for mines. Elk and deer are plenty, and as for trout, the lakes and rivers are alive with them. To the pleasure-seeker, the tourist and the lover of the grand, the curious and the beautiful in Nature, this region about Pen d'Oreille Lake and Clark's Fork of the Columbia offers the greatest attractions. It is a five-days' journey from San Francisco by steamer and railroad, and the trip is a continual panorama. Bidding a reluctant farewell to the beautiful Pen d'Oreille, I start for Palouse country in Eastern Washington.—*San Francisco Chronicle*. W.

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SUBWAYS AND LONDON STREETS.

In the growth of a city such as London the accruing evils of overcrowding its streets fail to attract the attention and consideration they deserve. To meet the increasing wants for shops, warehouses and dwellings, additional height of the buildings is provided, but the main and indispensable arteries of communication by which their comfortable occupancy can alone be secured remains neglected. The several and fluctuating widths of the Poultry, Cheapside, Ludgate Hill, Fleet street and the Strand may have been sufficiently commodious to meet the wants of a London population fifty years ago, but the most careless passer-by of to-day must be conscious that the constantly-recurring and almost chronic "blocks" are not creditable to our modern local government's intelligence. The dangers of the streets are too well known and their painful records too conspicuous to afford any excuse for so persistently neglecting or disregarding their constant recurrence. During some hours of the day a walk from the Mansion House to Charing Cross will prove to the most sceptical observer that other than existing provisions must be made to control and render comfortable such a traffic as that which prevails between the limits we have named. The crowded pavements and the no less over-burdened carriage-way proclaim the fact beyond doubt or cavil, that these lines of streets are incompetent to perform their proper functions, so as to secure safety to the crowds by which they are used.

Notwithstanding the inconveniences and dangers we have referred to, there is much indeed to be thankful for when we consider the onerous and complicated duties thrust upon the streets above and below their surfaces. Underneath, in positions and under such conditions which we had better not too minutely examine, there are innumerable pipes of earthenware, iron, and lead, all huddled in confusing entanglement. A more precise knowledge of what is below it is as well that the confiding householder should never attempt to gain. The telegraph wires, and in some localities the exhaust tubes used by the Post Office for the dispatch of light packages, are added to the long-accumulating deposits made by water and gas companies' pipes during many years. If, therefore, we feel, with good reasons, surprise at the confusion prevailing on the surface, we are the more astonished when an opportunity offers enabling us to examine the dangers lurking beneath. Danger, indeed, lurks there in no stinted form, as more than one unfortunate gas explosion has fully demonstrated.

Besides the danger from gas (seweral and illuminating), there are the decaying pipes, saturating from their state of leakness the soil in which they are imbedded, and thus storing up magazines of future plague-germs and other disease and death-dealing producers.

The three great necessities of life—water, light, and facile disposal of household wants—are secured in such a way as to reflect but little credit on our vaunted civilization and sanitary knowledge. A fire or a gas explosion, or a congested sewer, soon displays the shortcomings and dangers of some of the most crowded London thoroughfares. Yet under the pressure of any unusual strain on the water or gas companies' supplies, a break-down is too common, affording ample proof that London, with its boastful boards and vestries, is much behind in practical efficiency many a third-rate town in less favored districts of the British Empire. Many causes now operate to prevent that unity and compactness of interests which, under any circumstances, is so essential to good and efficient local government; but perhaps the most dangerous and unmanageable ingredients in this question are the vested interests of the gas and water companies. These peculiarly-privileged bodies, endowed with great and almost plenary powers, acquired under the authority of special legislation, usurp in the most reckless manner powers which it was never contemplated they should be permitted to enjoy. The most aggressive acts are committed in furtherance of the aggrandizing policy of these rapacious companies, who disregard all complaints and seem to delight in the knowledge that the great population of London is helplessly enthralled in their binding fetters of monopoly. Rich and poor are alike subject to their rapacity, and no modern parallel can be found to compare with the existing state of gas and water supply in the greatest city of this or any other time. A persistent and well-considered extravagance in needless works enables these giant companies to maintain a defiant position, proof against public feeling or state interference.

Practically, under such circumstances, the water and gas companies and their officials and workmen are lords paramount over the streets of London, interfering in their selfishness with any scheme of subways for the more safe and convenient reception of gas mains and water pipes. Early legislation will, we trust, change such a condition of things, and place in the hands of the public the gas, water and other supplies, when no obstacle would then exist to alter the scheme of indiscriminate pipe-laying as now carried on regardless of the inconveniences and dangers it occasions.

With a perfect knowledge before us of the causes which impede traffic, there can be no question of the desirability of immediate recourse to ample and well-conceived subways for accommodating all apparatus required for the supply of water, gas, and other necessary wants. We have already some moderate examples of subways in several of the new streets constructed by the Metropolitan Board of Works; but by some unpardonable legislative hitch when that self-asserting body was being clothed in its powers, full as they were at the time considered, it was found that the great monopolies of water and gas production and supply could not be compelled to use them. The Metropolitan Board constructed sewers and subways, but "gas and water" clung to their legal powers, and insisted upon disturbing the traffic by a maintenance of the right to lay down and deal with their pipes on the surface as hitherto.

Can there be for one moment any doubt in an intelligent mind that to continue longer apathetic on this most vital question would be to court and encourage a danger becoming daily more imminent? If there was any immediate prospect of a check to the prosperity of London, and therefore some chance of reducing the numbers of its population, then there might be a shadow of excuse for neglecting a matter of such paramount importance as the sensible government and control of its streets and thoroughfares.

Subways for London, more especially in its densely-populated centres and busiest streets, need not be constructed in the exact line of traffic, but take the most convenient routes competent to meet the present and prospective wants of the district they traverse. To construct a subway along the Strand would involve an outlay, measured not so much by the simple constructive character of the work itself, but by consequential damage to trade during progress of the works. In such direction also the dimensions of a subway would be limited to the narrow confines of such a thoroughfare, and quite inadequate to meet the wants of so crowded a district. A much more comprehensive scheme of subways must be contrived to meet not only existing wants, but provide against all coming improvements of whatever kind.

One great advantage which a substantial subway would secure, would be a good and sound foundation on which to build a double roadway. Of whatever materials carriage and footways are now composed, much of their inefficiency and costliness is due to the absence of a thoroughly reliable foundation. The constant reparation and relaying of London's busiest streets is consequent on the inability of the made ground or concrete to resist the shocks and concussions of the heavy, quick traffic passing over it. A roadway, well constructed and of the right sort of materials, would not be so troublesome or costly to repair, for, owing to the permanent character of the walls of the subway, the wearing or surface parts only would require renewal from time to time.

A well-devised scheme of substantial subways would be a costly matter, no doubt, but they would reduce much expense and inconvenience which is, under existing circumstances, unavoidable. It would obviate the necessity of opening up a street and stopping its traffic to make repairs to or re-lay a gas or water pipe, while it would also secure ready access to sewer pipes, and control with greater efficiency their dangers and shortcomings. In cases of fire there would be perhaps the greatest advantage secured, for while having at ready and instant command a supply of water, all the troublesome and confusing crowding consequent upon fires would not interfere with the firemen's duties. It would be desirable, of course, to inaugurate with a good system of subways a competent staff of men to regulate and keep under intelligent control all matters connected therewith, as well as to manage the necessary repairs and examinations. In all weathers the pipes and their contents in the subway would remain proof against the fluctuating influences of heat and cold, securing during extremes of temperature a reliable dependence on the various supplies which they are designed to distribute.

Such a subway scheme would indeed be a leviathan undertaking, but there can be no doubt that it would eventually pay, not only in a financial sense, but in an increased safety from many now almost uncontrollable dangers. To estimate fairly the saving which subways would secure, all and every outlay at present incurred by gas and water companies, vestries and other authorities, in repairs and changes of pipes and roadways must be taken into account. A check would be given to the monstrous expedients of the privileged companies to keep their income under by senseless works, so as to hold at arm's length all Government interference. Many a thousand pounds are thus squandered in needless repairs, so as to give an appearance of vigilant attention to the public wants, and at the same time secure for some favor a goodly income in making the necessary reparations to disjointed pavements and dislocated roadways.

But, alas! on reflection such a scheme as that which we have briefly outlined may be regarded under existing circumstances as the dream of a visionary, for there exists no authority competent to carry it out. The "City" fathers, the Metropolitan Board fashionables, and the vestries and suburban authorities, must be first welded into a homogeneous mass of efficiency before any such dream can be realized. The City and Metropolitan Board notables cannot be too soon restrained in their vagaries, so as to save the Thames from eventual *enshoalment* and the low-lying lands and houses on its banks from perennial flooding.—*London Architect.*

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A GALVANOMETER FOR ELECTRIC LIGHT CURRENTS.

At a recent meeting of the Society of Telegraph Engineers and of Electricians, England, a paper was read on a new galvanometer for measuring the most powerful electric-light currents. The action of the instruments is based on the *nil* method of testing—that is to say, reducing the deflection on the scale to *nil* by means of adjustments. The galvanometer consists of an astatic needle placed within two independent circuits, one a coil of long, fine wire, and the other a coil of short and very thick wire, which, in fact, is a stout hoop of brass in some forms of the apparatus. Through the short, thick coil, the electric lighting current to be measured is passed, and through the long, fine coil is passed the current from a single-standard Daniel cell. Resistance is included in the latter circuit until the two currents balance each other by differential action on the needle, and the deflection of the latter is reduced to *nil*. Then by means of a constant or multiplier found for the instrument in question by experiment, the strength of the powerful current in ampères can be obtained.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

THE PULSOMETER.—The success of the "New Pulsometer Steam Pump," arranged with boiler on small boats, built especially for the purpose of pumping out coal boats and barges, wrecking purposes, washing coal, putting out fires, filling boilers after cleaning, etc., by Messrs. Crowthers, Musgrave & Co., Eli Leonard & Son, O'Neal & Co., James McCleary and others on the Monongahela River has caused a demand for such boats. Messrs. Crowthers, Musgrave & Co. write that they can propell their boat four miles up stream and back in an hour by having the "new pulsometer" arranged to draw the water in at the bow, and forcing it out at the stern. Messrs. Gray, Shook & Co., 46 Water street, Pittsburg, Pa., agents for the "Pulsometer Steam Pump Co.," have lately built several of these boats to meet the demand, one of which has been purchased by Mr. James Sweeney, of New Orleans and sent South.

A SAN FRANCISCO GAS CONTRACT.—At its last session the Board of Supervisors made a new contract with the old gas company, binding the city to take all its gas from that concern for two years. Under this contract the rates are reduced so as to effect an annual saving to the city of about $45,000. This is an important point gained after a long controversy. The gas company, finding that it could not maintain its old fifteen years and five years' contracts, is glad to accept a two years' contract. Knowing that its rates were altogether too high, it reluctantly, and after a long fight in and out of the courts, yields to a reduction. Heretofore the cost per lamp has been about $50 per year. The reduction, as we understand it, is about $7 per lamp per year. This leaves the price at about $43 per year per lamp. In New York, the contract price for 1880 was $15 per lamp for the year of 4,000 hours. In 1881, the price was $17. A few of the lamps on the outskirts were a little higher, so as to raise the general average for the whole city to about $19. Between this and the price we are to pay under the new contract there is a margin of $24. We are to pay more than twice as much, and yet we are to get light for 2,860 hours instead of 4,000 as furnished in New York. Official reports show that gas costs no more here than in New York.—*Chronicle.*

Purification of Mississippi Water.—By a circular recently received we learn that the New Orleans Water-Works Company are prepared to enter into negotiations with parties who are able to solve the problem of thoroughly removing from the Mississippi water all the sediment contained therein, so as to render it fit to drink. The officers of the company believe that some apparatus can be found that will filter the water at the suction pump before entering into the pipe. For any such device they say the company can afford to pay a liberal sum of money. All correspondence should be addressed to E. A. Ducros, No. 60 Carondelet street, New Orleans, La.—*Exchange.*

The Consumption of water in Brooklyn on Tuesday last was 87,582,148 gallons, which is 2,000,000 gallons more than was consumed on the corresponding day of last year. The storage reservoir has run down from 10 to 9 ft. since Monday. At the meeting of the Board of Aldermen last week Mayor Low called the attention of that body to the advisability of increasing the water supply, and its committee on Water and Drainage was directed to co-operate with him in the matter.

An Illinois Oil Well.—The gas from the oil well at Litchfield was tested the other night, and found to be excellent for illuminating purposes. The test was made by conducting the gas through a 4-in. pipe to some distance from the derrick, and when lighted the flame shot up to the height of at least 50 ft., burning with exceeding brilliancy.

Increased Water Supply.—To provide an increased water supply for Springfield, Ill., it is proposed to sink a large well in the bottom of the Sangamon, which is relied on to furnish the city a supply of pure and wholesome water. It is the intention to sink such a well during the season.

The artesian well at White Plains, Nev., is nearly four hundrep feet deep. At forty feet depth the borders cut through a stratum of cement about four inches thick, and came to water that was very salt. Next they came to a deep bed of quicksand. Below it was gravel, and below that was a lava formation which has just given place to a bluish rock.

Tombsboro', Ga., has an artesian well 500 feet in depth, with a steady flow of fifteen gallons of water a minute.

ELECTRICITY.

Electric Traction Engine.—Experiments at a cost of $36,000 are being made at Berne with a view to traction through the St. Gothard tunnel by means of electricity.

Lighted by Electricity.—Last week the Brush Electric Light Company obtained a five years' contract for illuminating the cities of Rock Island, Ill., and Fond du Lac, Wis., and will start their tower system within three months at these places.

The Swan Incandescent Electric Light Co., of Boston, are setting a 60 horse-power Babcock & Wilcox boiler with the Jarvis furnace at their new workshop on Hampden street. They will use screenings for fuel.

Telephone Connection.—Clinton, Iowa, Aug. 6.—Telephone connection was established yesterday between this county and Davenport, which unites the exchanges of Clinton, Lyons, Camanche, De Witt, Davenport, Muscatine, Iowa, and Albany, Fulton, Morrison, Sterling, Rock Island, Moline, Geneseo, and other Illinois points. The longest distance is between Sterling and Muscatine, 106 miles.

Petoskey, Ind., expects to have electric lights.

The new electric light system will be in operation in Rock Island, Ill., about the 1st of October.

Messrs. Siemens & Halske, the well known electricians of Berlin, Germany, have recently built a factory in St. Petersburgh, Russia, for the manufacture of cables and other matters connected with electricity. They expect to be able, in this factory, to prepare some 2,000 miles of submarine cable every year, and the recent opening of the works was made the occasion of much congratulation. The erection of the factory marks only one of the periods in the steady improvement in Russian industries, and will undoubtedly render the country independent in telegraphic appliances.

The Wheeling (W. Va.), Electric Company is about ready for active operations. Their capacity at present is only for twenty lights, the rate charged for each light per night being seventy-five cents, including the putting in of the fixtures and all the attention required to keep them in order. Each light is equal to 2,000 cables.

RIVERS AND HARBORS.

The Potomac at Alexandria.—The work of improvement along the river front still continues, and more dredging has already been done this year than during the ten years previous. It is thought by some that the filling up of the Washington flats, by narrowing the water way of the river and thus making a quick flow through the narrowed channel in times of flood, will deposit the mud which is brought down by the floods in the wider portions of the river where the water way widens and the current becomes less swift. This, it is said, will have a tendency to injure the harbor of Alexandria. It seems probable, however, that the banks which form the mouth of narrow channels emptying into wider ones will form higher up the river, and no injury result to the harbor of this town.

Dredging in the Gulf Stream.—Hamilton, Bermuda, Aug. 2.—The Governor, attended by Mr. Hussy, A. D. C., and accompanied by the Hon. Mr. Boyle, Colonial Secretary, visited the United States Coast and Geodetic Survey steamer Blake, Commander J. R. Bartlett, U. S. N., on the 27th ult. previous to her leaving this port for Cape Hatteras. The Blake is on a voyage from New York down the Gulf Stream for the purpose of dredging and sounding in those waters. She is fitted with all modern appliances and has many improvements on the Challenger. She carries a Brush dynamo machine, which gives two side lamps of 2,000 candle-power each, and under these powerful lights work can be carried on at all hours of the night. The engines of the vessel are wonderfully compact and consume the small amount of four tons daily, though the average rate of speed is nine knots an hour. As the Blake carries over 160 tons of coal she can remain away from port with this consumption for six weeks. Her sounding apparatus is as near perfection as modern science can make it. Piano wire is used, which being wound on a patent wheel and sunk by an ingenious contrivance of weighting, enables a depth of three miles to be attained. Commander Bartlett in testing the Gulf Stream finds a bottom of ooze or mud in most places and the flow of heated water continuing to the lowest depth. Sixteen-strand wire cabling is used for the deep-sea dredging, and the dredger itself is so contrived that when the hauling in takes place the net is closely shut, and the various specimens are safely retained. The Blake has eight officers and thirty-eight men.

RAILROADS.

Railway Shops.—The St. Paul, Minneapolis & Manitoba Railway Company has at last decided to locate its railroad and repair shops at Barnesville, Minn., which will be the headquarters of the northern division. The shops will be the largest west of St. Paul.

The new branch which the St. Louis, Iron Mountain & Southern Railway Company proposes to construct in Arkansas is to run from Beebe, White County, in a generally westerly course to Fort Smith, on the line of the Indian Territory, and will be 160 miles long. The country through which it will run is unsurpassed for fertility of soil. The road will cross the Little Rock & Fort Smith Railway at Conway, Faulkner County; thence southwest to the Arkansas River, and after crossing to the south side, will run up the Valley of the Fourche La Fane River through Perry County and into Yell County; thence northwest to the Petit Jean River, up that stream and tributaries to the Sebastian County line; thence across the Voche Grasse River and Massard Creek to Fort Smith. The route is remarkably good for the road, the heaviest piece of work being a bridge across the Arkansas.

Winnipeg, Me., Aug. 6.—The work of extending the Canada Pacific Railway from Prince Arthur's Landing to Nepigon, north of Lake Superior, is to commence immediately. The survey of the road is complete from Winnipeg to the Rockies.

Work Begun on the Killbuck Valley Road.—Wooster, O., Aug. 7.—Work was commenced on the Killbuck Valley road from Wooster to the New York, Pennsylvania & Ohio road, near Burbank, to-day. Engineer J. F. Wallace arrived last week, and started out with his surveying corps this morning. The required amount of stock is about all subscribed, and the directors propose to push the work and have the road-bed built from Wooster to Burbank before the coming winter sets in. Bids for the construction are advertised for, and the work will be let on August 24. Bidders are notified that the plans and specifications of the road will be ready for inspection on and after August 20.

Extensions of the Chicago & Northwestern.—Three lines are in process of construction as extensions of the system. The longest of these, the Escanaba and Superior line, is ironed for twenty-four miles, and with the additional laying of twelve miles of track the extension will be complete. The other two branches, one known as the Crystal Falls and the other as the Iron River, are shorter. The former is about completed, and the latter in condition for track laying. These extensions were included in the projected construction for 1881.

Brisk Demand for Rails.—An officer of the Milwaukee, Lake Shore & Western road states that recently the company tried to negotiate a purchase of three thousand tons of steel rails from the Chicago steel mills. They were told that the order could not be filled before next fall; as the demand was greatly in excess of the capacity to supply. The company has closed a contract with the Joliet works. Construction of track on the company's extension in Wisconsin is progressing with dispatch.

Increase of Stock.—The stockholders of the Texas & New Orleans Railroad Company will meet at Houston, Tex., on the 15th inst. to increase the capital stock for extension of a branch line from Woodville, Tyler County, at the rate of $25,000 per mile. The construction of this branch will give Marshall direct communication with Sabine Pass.

The Little Rock, Mississippi River & Texas Railway opened a ten-mile extension from Monticello to Warren.

An Indian Railroad Survey.—The survey of the proposed railroad from Saginaw to Durand, via Flushing, is in progress.

A New Road.—Bourbon, Ind., Aug. 4.—Col. John Lee, President of the Michigan, Indiana & St. Louis Railroad, reports from New York that the contract for the constructing, building and equipping of said road was closed last Saturday with a syndicate of New York capitalists, who will begin operations about Sept. 1. The road will be a continuous line from Detroit, via Sturgis, Mich., and Danville, Ill., to St. Louis, and will pass about four miles west of this place. Local subsidies all along the line have been voted, except at this place.

The Joliet, Rockford & Northern.—The grading and bridge-building on the Joliet, Rockford & Northern Railroad, between Sheridan and Paw Paw, is expected to be done by Sept. 1. Then the iron will be put down and the road ballasted in thirty days, so as to be ready for the winter's coal trade.

Canada Atlantic.—A meeting of the Board of Directors of the Canada Atlantic Railroad was held at Ottawa Friday of last week. A resolution was passed authorizing a special general meeting of the shareholders to be held on the 29th of August, to consider and determine upon the issue of the first mortgage bonds to the extent of $15,000 a mile, the leasing in perpetuity of the Province Line Railway in the State of Vermont, and the issue of preference stock. The President in his report stated that the road is constructed and ballasted to within one-half mile of the Rideau River and the Rideau Canal, and will be fully completed within three or four days. The road is now graded to Ottawa, and the ties will be laid on this portion at once, and the ballasting of the whole line to Ottawa will be completed next week.

Prospect of New Lines from the Atlantic to the Pacific.—Denver, Aug. 1.—The *Tribune* notices a rumor that the Chicago, Burlington & Quincy Railroad Company, which now has direct connection with this city, contemplates the construction of a wide-gauge road westward from here up Chicago creek, following a direct route to the Pacific, and which will lessen the time from ocean to ocean thirty six hours. Surveying has been done through the town and up Chicago creek, but the surveyors are profoundly reticent when questioned as to the object of the survey.

The Ouachita Division of the Little Rock, Mississippi & Texas Railroad has been opened for business to Warren, Bradley County. Regular freight and passenger trains were put on on Monday, and the road is to be completed to Texarkana.

Burlington & Ohio.—The contract for laying ties and track has been let to Albert Michelson, representing the Moore Railway Construction Company, of Chicago. The grading between Carlinville and Gillespie is about to be let. It is expected to have trains running on part of the line within ninety days.

The Kingston and Pembroke Railway Company have commenced to lay steel rails on their road. The whole road will be laid with steel rails by the time the junction with the Canada Central is effected.

City of Mexico, Aug. 10.—The Tehuantepec Railroad Company having forfeited its charter, the Mexican government has resolved to complete the road as soon as possible. The company will be paid for the work done and the material on hand. The work will be continued under the charge of Gen. Porfiro Diaz, as Governor of Oaxaca. Delfino Sanchez, ex-Superintendent of the Morelas Railroad, has been appointed Purchasing Agent. He will soon start for the United States to buy rails and rolling stock. The Toluca Division of the Mexican National Railway, extending from the City of Mexico to the city of Toluca, was to-day approved by the Government, and the road is opened to public traffic.

BUILDING.

New Elevator—The excavation for the new mammoth elevator in the lower part of Peoria, Ill., has been completed, and material has already begun to arrive for the building. There will be a force of 200 men employed for a number of months in its construction.

Prize Plans for Shool-Houses.—A communication was received from Mayor Low at the August meeting of the Brooklyn Board of Education, offering prizes for the best plans for school-houses. The offer included $250 for the best plan of a school-house to cost $15,000; $200 for the best plan of one to cost $20,000, and $150 for the best plan of one to cost $25,000. These prizes are open to competition on the part of architects, and they will be awarded in accordance with the decisions of a committee appointed by the President of the Board, the Chairman of the School-house Committee, the Superintendent of Public Instruction, and the Commissioner of Buildings. The Mayor's offer was accepted.

Court-House.—Work on the court-house at Fond du Lac, Wis., has been stopped for awhile on account of the supply of bricks giving out.

Building in Quincy, Ill.—Considerable building is going on in different parts of the city of Quincy, and the residences which are being erected are all nice ones.

Austin, Texas, is to have a $250,000 hotel.

Takis, Atchison Co., Mo., is to have a court-house built of brick, two stories high, 90 feet square, to cost $30,000.

New car shops are to be erected at Stony Island, Ill., near Chicago, for the New York, Chicago & St. Louis railroad.

BRIDGES.

A New Bridge over the St. Lawrence.—The building of the new bridge over the St. Lawrence above Montreal, at Lachine, which is now projected, will open a new era in the railroad intercourse of Canada and the States. All the roads now entering Montreal from this country pass over Victoria Bridge, and pay toll to the Grand Trunk Railroad. It is intended to afford the use of this bridge to all roads which ask for it. This bridge is to be a double-track truss, costing about $2,000,000, and being opposite the Lachine Canal does not interfere with the shipping on the river. The present monopoly of the Grand Trunk over the Victoria Bridge has been exercised with great severity toward other roads at times, a toll of $5 a car each way for passenger cars being the frequent charge.

Moving a Bridge.—A bridge built near Fond du Lac for the Milwaukee and Lake Winnebago railroad is being uncapped and moved over about nine feet. The bridge is 192 feet long, and was built nine feet out of the way of the survey for the track.

ENGINEERS AND ENGINEERING IN OTHER LANDS.

[Specially translated and prepared from our exchanges.]

The "din of arms" bids fair to stop a few of the contemplated Oriental engineering works. The fabulous success of the Suez Canal was attracting the attention of capitalists to various undertakings, but they are either being subjected to a closer scrutiny or are indefinitely postponed. In the meantime attention has been called to the fact that the great steamship of the future—for we are not yet satisfied with such "swift-footed" monsters as the Alaska—will be too huge to go through the Suez Canal, which in its present form requires almost a specially built steamer, and thus the voyage round the Cape of Good Hope may come into favor again, as the superior speed of such steamers would considerably reduce the advantage now possessed by the Suez route. However, this is a rather long viewed argument, although the Suez Canal will doubtless be deepened when peace reigns once more in Egypt. Neither does the projected canal from Bordeaux to the Mediterranean meet with much favor from sensible capitalists and thoughtful engineers. A steamer entering such a canal at Bordeaux would have to pass forty locks, and would only be at Narbonne, while the second, with a full head of steam on, would have passed Gibraltar. Considerations of the comparative safety and navigation of the two routes are not in favor of the project. Still it is a "job" of 1,500 million francs ($300,000,000) and French politicians, no more than our own, are not unamenable to the reasons which the disbursement of such a vast sum carries with it.

M. de Lesseps has, of course, his hands full on "the Grand Canal," but his last report about the Panama one shows that American contractors will in all probability dig it, if it is to be. Huerne, Slaven & Co., of San Francisco, are to excavate between Colon and Gatun, to the extent of six millions of cubic metres at the rate of 1 fr. 50c. per cubic metre. Say in round numbers a job of $2,000,0000, if, however, there are more than six million metres, then the price is only 1 fr. 25c. An American company also undertook to excavate ten kilometres of the canal on the Panama side. But de Lesseps recommends that the system of interesting the engineers and employés in the rapid completion of the work by giving them a pecuniary premium or share, as was done in the Suez Canal, be adopted.

M. Laterrade promised to send an account of his system of leveling with marking out to the *Annales des Ponts et Chaussées*. In the meantime he contributes the following summary to the *Revue Industrielle*.

The slide of the telescopic level with air bubble is nothing but a sliding frictional cylinder. However well made a glass may be, there is always a certain amount of "play" between the two cylinders. The consequence is that the weight of the eye-piece and of the outer part of the slide cause the latter to oscillate, and the optical axis is raised.

This defect, which is scarcely perceptible in new and well made instruments, is often very prominent in old and worn out ones. It is not always possible to correct this by placing one's self at an equal distance from the two leveling staffs if the glass is moved for more than one marking, as the oscillation is not uniformly regular on account of the friction. A single marking out is therefore advisable, and we have tried it on such an extended scale that we can guarantee more satisfactory results by this method than with the ordinary one. We have thus surveyed:

1. A circle of 7 kilometres in length, comprising 108 stations in which the rise was 120 metres above the starting point, and the close 0.10 metres.

2. A line of 27 kilometres in length in a plain, comprising 245 stations, and making part of a circuit of 100 kilometres.

3. A line of 82 kilometres, containing 868 stations, making part of a circuit of 175 kilometres; the rise was up to 192 metres from starting point, closing at 0. M. .021.

The average assumed error per station obtained by dividing by number of stations the total of the absolute values of the partial differences between the first, and the verifying leveling was only 0.0018 metres in the first instance and 0.0012 in the third. This last is the greatest degree of exactness we could obtain, and we believe it will be difficult to surpass it in practice.

All exact leveling should be staked out so that the staffs rest either on an iron cylindrical bench-mark or on a strong wooden picket with round head. When leveling with one marking, it is necessary to stake out the place of the level, as this must be at an exact distance from both leveling staffs, and there must be no chain work or testing when verifying for the level. At the same time there is no reason to exaggerate the nicety of the distance from the level to the staffs—0.20 M. or 0.30 metres will be quite near enough.

The rapidity with which surveying can be done by this method will astonish those who have not been accustomed to it. The first operation is naturally the longest, on account of the double staking out which is requisite, however, it can be proceeded with at the rate of from 8 to 10 kilometers a day; in verifying, from 15 to 16 kilometres can be done, and even up to 21 kilometers. Of course a vehicle is necessary in this case, if only for carrying the pickets and for conveying the men when verifying. When surveying by the stadium no reader is required, for being always at an equal distance from both staffs, the figures, both in front and rear, must always be the same, which is in itself a sufficient verification. If surveying by the stadium is not adopted, a reader must be employed. However, he need not use a special book, as the operator writes down the figures of the reader, if exact, below his own.

A method for insulating the masonry of vaults and trenches has been recently employed with much success in Germany. It consists in several sheets of asphalt, separated from one another by layers of some long-fibered vegetable, as flax, jute or cotton. These give the sheets of asphalt great flexibility and tenacity, even under low temperature, as is the case so often in tunnels. The asphalt sheets should be about 13 millimetres thick, and they can be heated on the spot. It is not necessary that they form a body with the masonry, but only to make a watertight revetment. Liquid asphalt may be poured between the joints.

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BIDS FOR FREMONT, O., WATER-WORKS.

On July 25 the Trustees received bids for
3,400 lineal feet of 16-inch pipe,
5,600 " " 12 " "
4,900 " " 10 " "
5,600 " " 8 " "
26,700 " " 6 " "
10,200 " " 4 " "
} 1,400 tons.

Also, 18 tons of special castings.

Also, for furnishing lead and gaskets and laying said pipe, including trenching and back-filling, setting hydrants and valves, including the furnishing and setting valve-boxes, vaults and covers.

Also, for furnishing ninety-five hydrants.

Also, for furnishing valves as follows: Three 16-in.; three, 12-in.; five, 10-in.; eight, 8-in.; forty-five, 6-in.; and twenty-seven 4-in. valves.

Also, for furnishing materials and erecting one metallic stand-pipe, 25 ft. diameter and 100 ft. high, including foundation for same.

Also, for pumping machinery, as follows: One compound or condensing engine of capacity to pump 2,000,000 gallons of water in 24 hours against 225 ft. head, and one non-condensing engine of 1,000,000 gallons capacity under like conditions, including engine foundations.

Also, two return tubular boilers approximately 5 ft. 4 in. diameter, 16 ft. long, including foundations, settings and connections.

Also, one brick building, to be subdivided into an engine-room about 40x40 and boiler-room of same dimensions, together with coal-room, tool-room and office-room, as per detailed drawings.

Also, one brick smoke-stack, 100 ft. high.

The following bids were received:

PIPES AND CASTINGS.

Dennis Long & Co., Cincinnati	$53,255.68
Cincinnati & Newport Iron & Pipe Co., Newport, Ky	51,102.00
R. D. Wood & Co., Philadelphia, Pa	55,160.00
Gloucester Iron Co., Gloucester City, N. J	60,895.00
A. H. McNeal, Burlington, N. J	52,572.00
L. S. Foundry, Cleveland, O	52,780.00

PIPE LAYING.

J. E. Driesbach, Elyria, O	$19,758.00
MacRitchie & Nichol, Chicago	17,902.00
MacRitchie & Nichol, Chicago, furnishing and laying, setting valves and hydrants	74,900.96
H. N. P. Dole & Co., Columbus, O	16,840.25
James Boylan, Fremont, O	22,664.00
J. L. Rawson, Fremont, O	32,750.00
R. B. Carothers, Newport, Ky	15,440.00
R. B. Carothers, Newport, Ky., furnishing and laying, setting valves and hydrants	68,789.00
Thomas B. Keating, Mansfield, O. (no bid on 10-in. pipe)	14,528.00
James J. Newman & Co., Brooklyn, N. Y	19,656.00
D. A. Chappel, Chicago	21,205.00
D. A. Chappel, Chicago, furnishing and laying, setting valves and hydrants	78,600.00
D. F. Manahan, Springfield, O	17.446.00

ENTIRE WORK.

D. F. Manahan, Springfield, O., pumping machinery, valves and hydrants, at trustees' option	144,848.00
Holly Manufacturing Co., Lockport, N. Y., works complete except stand pipe	134,400.00
R. D. Wood & Co., Philadelphia, Pa., works complete with Knowles' pumping machinery, excepting stand-pipes, brick masonry, cast-iron vaults, corners and frames and concrete	110,000.00
R. D. Wood & Co., Philadelphia, Pa., brickmasonry, $12 per M.; castings, 4c. per lb.; concrete, $6 per yard.	

VALVES AND HYDRANTS.

Hutchinson & Alexander, Allegheny, Pa	5.915.29
Chapman Valve Co., Indian Orchard, Mass	7,037.82
Boston Machine Co., Boston	6,704.50
Ludlow Valve Mfg. Co., Troy, N. Y	6,592.30
Mohawk & Hudson Mfg. Co., Waterford, N. Y	6,044.30
Julius Jonson & Co., New York	7,866.50
R. D. Wood & Co., Philadelphia, Pa	6,528.00
Jas. Flower & Bros., Detroit, Mich	6,865.77

PUMPING MACHINERY, BOILERS AND FIXTURES.

Thos. McGregor, Detroit, boilers and settings	4,730.00
D. June & Co., Fremont, O., boilers and settings	3,450.00
J. P. Merriam, Sandusky, O., boilers and setting	4,750.00
W. S. Jarboe, Pittsburgh, Pa., pumping machinery and boilers	14,500.00
W. S. Jarboe, Gaskill's engines and boilers complete	22,000.00
H. G. Moore, Sandusky, O., boilers and settings	3,371.00
Knowles Steam Pump Co., N. Y., pumping machinery and boilers	14,388.00
Knowles Steam Pump Co., N. Y., pumping machinery without boilers	10,350.00
Knowles Steam Pump Co., N. Y., boilers complete	4,038.00
Geo. F. Blake Mfg. Co., N. Y., pumping machinery and boilers	14,330.00
Geo. F. Blake Mfg. Co., N. Y., pumping machinery without boilers	10,030.00
Holly Mfg. Co., Lockport, N. Y., pumping machinery and boilers	25,700.00
Holly Mfg. Co., Lockport, N. Y., Gaskill's pumping engine, boilers and settings	23,000.00
Cope & Maxwell Mfg. Co., Hamilton, O., pumping machinery and boilers	18,900.00

STAND-PIPE AND FOUNDATION.

H. G. Moore, Sandusky, O., complete	23,998.00
Jno. McGregor & Son, Detroit, excepting stairway and cornice	15,500.00
Buckeye Bridge and Boiler Works, Cleveland, O., above foundation	20,235.34
Stacy Manufacturing Co., Cincinnati, above foundation	19,869.31

Thomas McGregor, Detroit	15,400.00
J. P. Eldarkin, Fremont, O., foundation complete	6,525.00
James Boylan, Fremont, O., foundation, puddling and paving	12,978.00
Dennis Hannan, Toledo, O., foundation.	8,665.00
J. K. Cramer & Co., Toledo	5,460.60
BUILDINGS AND SMOKE-STACK.	
Theo. Brockman, Fremont	$12,418.00
J. P. Elderkin, Fremont	11,500.00
C. Whittingham & Co., Toledo	10,550.00
James Boylan, Fremont	12,000.00
J. K. Cramer & Co., Toledo	16,600.00
Wm. A. Huderson, Fremont	11,091.00

THE FIRST GAS WORKS.

In 1798 Murdoch built the first gas-works of any magnitude at Messrs. Boulton & Watt's factory, at Soho, near Birmingham, where a great sensation was made by a triumphant illumination on the occasion of the peace of 1802; and six years later Murdoch received the gold medal of the Royal society as the reward of his ingenuity and perseverance. Though the adaptability of gas for lighting purposes was thus proved, the cleansing process was as yet very defective. With a view to improvement in this and other respects, a series of experiments was made by a German named Winsor, at the commencement of the present century. In 1803 his first public experiment was made, the Lyceum theatre being then for the first time lighted with gas. A course of lectures delivered by Winsor, explaining his system, during the following year, led to the formation of the first gas company, with a capital of £50,000, the whole of which was expended in experiments without bringing any return to the shareholders. Three years later Winsor exhibited his new light in a row of lamps in front of the colonnade before Carlton house, then standing in Waterloo place. But his scheme was ridiculed by the scientific authorities of the day, and his application for a charter in 1809 for the National Light and Heat Company was refused at the instance of Murdoch, who, however, subsequently withdrew his opposition, and the company was incorporated. Still public prejudice remained unconquered. Sir Humphrey Davy himself gave it as his opinion that "it would be as easy to bring down a bit of the moon to light London as to succeed in doing so with gas," and in 1813 the inquest men of St. Dunstan's prosecuted William Sturt, of No. 188 Fleet street, for "the making of gas-light and making and causing to be made divers large fires of coal and other things; by reason whereof, and divers noisome and offensive stinks and smells and vapors, he caused houses and dwellings near by to be unhealthy." In spite of prejudice and opposition the work went on, and in 1814 William Knight started a company and built gas-works at Whitefriars, and on Christmas day of that year the fate of the old oil lamps was sealed; the metropolis was for the first time generally lighted with gas.

By 1282 Winsor's company already owned 122 miles of pipe in the London streets, and was supplying 680,000 cubic feet of gas nightly, and twenty years later there were no fewer than eighteen public gas-works in London, employing a capital of £2,800,000 and manufacturing 1,460,000,000 cubic feet of gas per annum. The last public place in London to adopt the new-fangled illumination was Grosvenor square, which resisted the tide of progress until 1842. Then, at length, the street oil-lamp finally disappeared and the face of linkmen became extinct, nothing remaining to remind us of their existence except the great extinguishers which may still be seen at the doorways of many old houses. Gas had won the supremacy which it has now maintained for three-quarters of a century, and which it must soon again yield up to its more powerful rival.—*St. James' Gazette.*

THE ENTRANCE HALL AT ABBOTSFORD.

The entrance hall at Abbotsford, the home of Sir Walter Scott, is forty feet in length. Its lofty ceiling of oak, fashioned into a series of arches, is exquisitely carved; the walls, which are also of oak, from Dumfermline Abbey, are richly decorated in the same manner. The floor is made of black and white marble from the Hebrides. Along the walls are many suits of old armor, the most noticeable being an English suit of the time of Henry V., and an Italian one of more recent date; above them are the coats of arms of the ancient border clans, conspicious among these being the arms of Douglas and the Royal Lion of Scotland. There are also helmets, rapiers and claymores in great variety, as well as Polish lances, and a suit of chain mail taken from the corpse of one of the royal body-guard of Tippoo Sahib, ruler of Seringapatam, when that Hindoo city was besieged and captured by the English in 1799. On one side, in a niche formed by a window, is a glass case containing the last suit of clothes worn by Sir Walter. Hanging on the wall, at the extreme end near the left door, are the keys of the old Tolbooth prison. There are also relics in this entrance hall of James VI., and Claverhouse, the "Bonny Dundee" of Scottish prose and poetry. Only two windows light the hall, and they are so obscured by coats of arms that the interior has been spoken of as being "as dark as the twelfth century." I leave my young friends who study history to decide how dark that is. Standing in one of the corners, but not visible in the picture, is an American axe that was much prized by Sir Walter as the gift of Washington Irving. Many of you have doubtless read Irving's description of his stay at Abbotsford. It is a fine tribute to the host who entertained him so royally. The farewell at the gate was "I will not say good-bye, but come again." Irving tells us that he was so impressed while there with the fact that Sir Walter, notwithstanding the miracles of work he did, contrived to be ever at the command of his guests, continually devising plans for their enjoyment.—*From "A Visit to the Home of Sir Walter Scott,"* in ST. NICHOLAS *for August.*

THE POTOMAC RIVER.

Mr. S. T. Abert, United States civil engineer, has submitted to General H. G. Wright, Chief of Engineers, his annual report upon the improvements of the Washington and Georgetown harbors. He gives a history of the work from the 11th of July, 1870, to June 9, 1881, when proposals were asked for dredging between the northeast end of the Long Bridge and Greenleaf's Point, United States Arsenal. The contract, which was awarded to the National Dredging Company, of this city, at the rate of 24 cents per cubic yard, provided for dredging the Washington channel to a depth of 15 feet at low water, and to a width of 200 feet, or as much as the funds would permit, the material to be deposited on the harbor flats, next the causeway of the Long Bridge. The work was commenced December 5, 1881, and continued night and day, with the exception of necessary delays, and when operations ceased, June 1, 1882, 240,111 cubic yards of material had been dredged. The excavation was made with a clam-shell dredge, and dumped upon the flats by means of a tramway. Mr. Albert's estimate of the cost is 16.85 cents per cubic yard. In regard to the

GEORGETOWN HARBOR AND CHANNEL

the report states that by the utilization of $15,000, which had not been specifically appropriated for this work, together with $30,000, which belongs to it, some work could be done, and work was commenced on the bar below Easby's Point, June 12, 1882, by the Potomac Dredging Company, to whom the contract had been given for twenty-eight cents per cubic yard, and is still in progress. The report states that the safety of navigation in Georgetown harbor would be much increased by the excavation of rocky points, some of which are found near the wharves and at dangerous depths at other points in the channel. Near the inclined plane there are 1,600 cubic yards to be removed, to a depth of nine feet at low water; three hundred and ninety feet below the Aqueduct, 104 cubic yards; southwest of mill sluice 489, Kennebec Ice Company, 211, 74, 128, 171, and 118 cubic yards to be removed. G street wharf, 34.5, 87, and 889 cubic yards. Northwest of Analostan boat-house, 6,000 cubic yards; work not needed now. No award for rock excavation was made because proposals could not be had for less than $28 per cubic foot, which is regarded as excessive.

For the fiscal year ending June 30, 1884, an appropriation of $800,000 is recommended. During the past year $1,443.38 was expended on the improvement of

THE POTOMAC AT MOUNT VERNON,

for which there is no appropriation this year; $5,000 is recommended for next year. In reference to other points on the Potomac Mr. Abert states that the amount available for the fiscal year for improvement at Breton Bay (Leonardtown) is $5,008.95; estimated amount required for the completion of existing project, $10,000; amount can be profitably expended in year ending June 30, 1884, $10,000. For the improvement of Nomini Creek the sum of $2,000 is appropriated for the present year, and $10,000 is asked for the ensuing year. For the improvement of harbor entrance to St. Jerome Creek, Maryland, $6,000 is appropriated for this year, and $10,000 asked for next year. For the improvement of Neabeco Creek no appropriation was made for the present year. Last year $4,701.70 was expended, and a balance of $286.67 remains. The sum of $51,000 is estimated to complete the improvement, and $20,000 is asked for next year.

THE South Pennsylvania Railroad Company have about two hundred men engaged in the surveys of their line. Location is nearly completed, revisions being the chief order of the day. The office of the company is at 67 Broadway, New York. Oliver W. Barnes is Chief Engineer.

MEXICAN NATIONAL RAILROAD.

Some remarks made last week in this column in regard to the sale of $5,000,000 bonds of the Mexican National Railroad to an English syndicate, have elicited several letters from persons interested in the scheme, including one from an official of the company. He says that President Palmer has never announced that he had succeeded in placing $10,000,000 bonds. This may be so, for General Palmer was abroad at the time. But the statement was publicly made, and no contradiction of it was given by any of his associates here, who are very sharp fellows. The said official also thinks that General Palmer, "as a gentleman," could not mention how many or how few cents on the dollar the London syndicate has agreed to pay. But General Palmer, "as a business man," might possibly have vouchsafed some sort of information on this subject, particularly as the completion of the road within the specified time must depend upon his success in raising money.

The securities of the English railroad from Vera Cruz to the city of Mexico are on the London Stock Exchange, and so are the Mexican Government bonds. But they have been there for many years, and this has nothing to do with the likelihood of Gen. Palmer's procuring a quotation for his Mexican enterprise. In the spring of 1880, when the representatives of this concern were "lobbying" in the city of Mexico for concessions, an agent of English capitalists was also there, ready to undertake the construction of railroads in Mexico if some arrangement was made in regard to the Government bonds, and it was only the influence which Gen. Grant brought to bear during his visit to Mexico that decided the question in favor of the American party. Had the bond business been arranged with England, diplomatic relations between England and Mexico would have been resumed.

It has also been attempted to controvert the statement made in this column that it is only lately that the railroad from Vera Cruz to the city of Mexico has become a paying concern. That the statement is correct will be seen at a glance from the following figures: The ordinary share capital or common stock of that company is $11,260,150. There are, in addition to that, $12,770,500 of first preference shares, $5,050,800 of second preference shares, and $10,000,000 in 6 per cent. debenture stock. In order to pay the charges on the three last the sum of $1,905,228 is needed, and in no year until 1880 was this amount earned over the running expenses. In 1880 and 1881 the construction of the American railroads began, and the English railroad made large profits by charging $30 a ton for transporting railroad material from Vera Cruz to the city of Mexico. Any one can see that this kind of business can only be temporary. Besides, it would be absurd to compare the magnificent Vera Cruz & Mexico road, passing through the very garden of the land, with the hastily built "Mexican National," running through the maguey plantations and cactus groves of the northern wilderness. Mexico may get civilized some day, and its railroads may become paying concerns; but no substantial improvement in that line is likely to take place during the present generation.—*N. Y. Sun.*

ADVICE TO A YOUNG MAN.

BOB BURDETTE.

Keep up with the procession, my boy. Don't hang back in the breeching. You may be able to make things drag a little, but you can't stop the team, and you'll have to come along. There was a man, an eminent mathematician Dr. Lardner, of England, who published a treatise to prove that no steamship could ever cross the Atlantic Ocean, and the steamer Sirius, a few weeks later, brought the first copies of his pamphlet to America. This same eminent scientist also "staked his reputation as a man of science," before the House of Commons, on his statement that no railroad train could ever go faster than ten miles an hour, and the slightest curve would invariably throw it off the track. Babinet, the French calculator, declared that no telegram could ever be transmitted from Europe through the Atlantic to America. There was a man right here in America, only one hundred years ago, who opposed the rebellion of the colonies because he knew it would be a failure. There was a man who laughed himself sore at Fulton's absurd ideas about steamboats. There were members of Congress who wanted Morse shut up in an insane asylum because he talked about a telegraph, which was an impossibility. There was a man who said you could never build a bridge across the Mississippi. There was a man who said you could never raise wheat on the great American desert. There was a man who swore he would call the roll of his slaves in the shadow of Bunker Hill monument. There was a man who "knew" that nothing but a steam-horse could ever trot inside of 2:40. There was a man who "knew" you couldn't make the sun draw your portrait. There was a man who "knew" you could never find a better light than a whale-oil lamp. There was another man who knew you could never beat lard-oil. There was another man who said Colonel Drake was a gibbering idiot because he said he could pump a better oil than lard-oil out of the ground like water. There was another man who said Edison was insane when he talked about an electric light. There was another man who said the phonograph was a clever trick of ventriloquism. There was a man who said the telephone was a newspaper lie. There was a man in England who led mobs of agricultural laborers to destroy threshing machines. There was a man in America who "knew" the invention of the sewing-machine meant starvation for the poor seamstress. And there is a man to-day who says all people may come to America, save only the Chinese. There is a man who "knows" the Indians can never be civilized. There is a man who "knows" we have reached the limit of human progress. There is a man who "knows" the gigantic corporations will devour the country. There is a man who "knows" the people are helplessly enslaved, and will never rise to assist themselves. There is a man who "knows" that all politics are corrupt, all politicians mercenary, the civil service rotten to the core, and our social life is honey-combed with decay. Now, my dear boy, there's only one way for you to escape that man's whining and obstinate, mulish opposition to everything. Keep so far ahead of him you can't hear him. And do you keep moving and drag him along. Rasp him with the doubletrees; he has to come, for the old chariot never stands still a second. The difference between you and that man, my boy, is that you run and he is dragged. You spring along, with your eyes open, your head erect, and you help to keep things moving. He has his feet set in the road, his eyes shut tight, his back up on his shoulders and his heart under the wheels. Every time you make a leap you throw the dust back in his face. Don't, my boy, whatever you do, don't get back beside that man. Don't have any breeching on your harness. Put on a breast collar, and that is enough; you'll run more lightly and feel freer. Let the man in the breeching hang back. All that you have to do is to step out, keep pace with the times, sing as you march and keep the man in the breeching so covered with dust the world will only know he's there by the dirt around him. It may be, Telemachus, you will run a little fast sometimes; it may be that you will kick over the traces in your exuberance of spirit; you may sometimes want to strike a 2:19 gait on a 3:30 road; you may need more curb than whip, but go it, my boy. There is a good driver on the seat, and a firm hand on the lines, and I'd rather see you coming down the long vistas of history with the bit in your teeth, your heels in the air, the brake-rod sprung and the dashboard flying, than down on your haunches, your eyes shut and your back bowed, the lash on your flanks and your collar up to your ears, your legs set like crowbars and the dust of the whole team flying in your face, while you hang back in the breeching and only come along because you can't help it.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page 279.*)

CCCLXXII.—PORTSMOUTH, O.

Portsmouth, Ohio, in lat. 38° 58', long. 83° W., is on the Ohio River at the mouth of the Sciota, on a nearly level plateau, extending back about a mile from the river to a range of low hills.

Settled in 1798, it was incorporated as a town in 1815. Water-works were built by the city in 1871, under the superintendence of W. C. Weir, taking the supply from the Ohio River, through 210 ft. of brick and wood conduit, and pumping directly into the mains by a steam engine, driving six piston pumps of 14-in. diameter and 14-in. stroke, built by the Holly Manufacturing Company. The ordinary pressure is 45 lbs., and the fire pressure 110 lbs.

Distribution is by 18 miles of cast-iron pipe, of from 16-in. to 4-in. diameter, with 90 fire hydrants, 102 gates, and 1,220 taps. Wrought-iron service pipes are used.

The population in 1880 was 11,314, and the daily consumption in 1881 was 1,900,000 gallons.

The works have cost $200,000. There is a bonded debt of $150,000 at 8 per cent. interest. The gross receipts have been $151,525.28. The expenses for the year ending May 1, 1882, were for maintenance, $11,596; for extensions, $3,220.41. The receipts were $13,881.40. Interest on bonds is paid by the city. The works are controlled by three Trustees, one being elected each year. Charles Zeigler is the Superintendent.

CCCLXXIII. TRENTON.

Trenton, New Jersey, in lat. 40° 13', long. 74° 46' W., on the Delaware River, is on undulating ground, rising in some places to 100 ft. above the river. The Assanpink Creek flows through the city. It was settled about 1760.

In December, 1801, the Legislature passed an act reciting that: "Whereas Stephen Scales hath represented that he hath purchased a spring in the city of Trenton, from which he can conduct the water through several of the streets of the said city, thereby supplying the inhabitants with plenty of sweet and wholesome water, provided he can be authorized to lay his trunks through some of the intervening lots," the privilege of so doing was granted to him. Under this act a stock company was formed with a capital of $1,200 and to which a charter was granted in December, 1808. The water from this spring supplied the citizens until 1832 when the company was authorized to take water from the Delaware River, and to build reservoirs. A 10-in. pump driven by water-power from the Delaware was erected, lifting the water into a reservoir holding 1,415,000 gallons, 100 ft. above the river. The company expended $86,000 on the works, and in 1856 the city purchased the majority of the stock, issuing bonds for the same. Fire hydrants were put in first at this time.

In 1856, an additional reservoir was built, after plans of Charles Potts, C. E., and in 1868 a steam pumping engine was built by William Carr, of 12-in. pump bore.

In 1876, a compound beam engine, operating a 16-in. pump, was erected by William Wright.

The combined pumping power at the works will deliver 4,000,000 gallons daily, and the reservoirs contain 15,000,000 gallons.

Distribution is by 32 miles of cast-iron pipe, of from 16 to 2-in. diameter, with 185 fire hydrants and 5,388 taps and 38 meters.

The population in 1880 was 29,910. The daily consumption in 1881 was 1,275,126 gallons.

The cost of the works to Feb. 1, 1882, has been $827,000.

The bonded debt is $265,000 at 6 per cent. interest.

The expenses in 1881 were, for maintenance, $9,774.48; for interest, $15,850, and for extensions, $4,893.77.

The receipts were $47,674.59.

The works are managed by a board of six commissioners. John J. Sager is the Secretary and Treasurer, and John B. Quigley the Superintendent.

[TO BE CONTINUED.]

CORRESPONDENCE.

GARDAM'S PATENT V LEVEL.

NEW YORK, Aug. 15, 1882.

EDITOR ENGINEERING NEWS:

DEAR SIR: We notice, in your valuable issue of Aug. 12, 1882, a statement from F. E. Brandis, of this city, to the effect that we are infringing upon his patent. In reply, we simply say that a patent has been granted to us by the United States government, No. 260,473, date of issue July 4, 1882, and therefore we do not think that we are infringing upon his rights in any way. Also, we hold ourselves responsible at all times for any damages that F. E. Brandis may obtain against us; and we will fully protect any one of our customers or purchasers from any damages that may be obtained against them.

By publishing this you will greatly oblige us. We are yours respectfully,

W. GARDAM & SONS.

PROBLEM.

COLD SPRINGS, N. Y., Aug. 15, 1882.

EDITOR ENGINEERING NEWS:

Can you furnish a reader through the columns of your valuable paper a solution to the following problem:

Required the side of an equilateral triangle within which a point is situated, distant from the vertices of its different angles respectively 20, 28 and 31 ft. Respectfully,

HENRY THOMPSON.

A PROBLEM IN ALGEBRA.

BOSTON, Aug. 9, 1882.

EDITOR ENGINEERING NEWS:

As a constant reader of your valuable columns, may I inquire if the equations

$$\left\{\begin{matrix} x^2 + y = 11 \\ y^2 - x = 1 \end{matrix}\right\}$$

can be solved? A number of interested readers await your answer. Respectfully, etc.,

AN ENGINEER.

[Only the answers will be published; to give the method (except possibly one case) is quite unnecessary.—ED. ENG. NEWS.

THE NEW CHARLESTOWN (MASS.) BRIDGE.

The Special Commissioners on the New Bridge between Boston and Charlestown have recommended an elevated structure described as follows:

The structure of the new avenue and bridge, which begins to rise at Traverse, on the westerly side of Charlestown street, is solid filling, supported by retaining walls, for a distance of about 470 ft., with a rising grade of 3⅛ ft. in a 100. Thence to the northerly side of Water street, in Charlestown, it will be carried on iron trusses of different lengths, resting upon granite piers. The span over Causeway street is 150 ft. long. Then come four spans of 75 ft. each, placed on a rising grade of two and twenty-eight-one-hundreths ft. in 100. After these, at a level grade, are six spans, one of which is the draw, each of 100 ft. in length.

These are followed by six spans, of 75 ft. each on a falling grade of two and three-fourths ft. in 100, one of which is over the tracks of the Fitchburgh Railroad, and another over Water street. Thence to City square, with a falling grade of 4 ft. in 100, and a distance of about 225 ft.; the structure is solid filling, again supported by retaining walls. The trusses of all the spans, except at the draw and where the railroad and streets pass under the bridge, are below the roadway. Three trusses are used for each fixed span. The draw is a pivot draw of the full width of the bridge, revolving end for end and moved by steam power.

The estimated cost of this new avenue and bridge is placed at $1,222,000, of which $782,000 is for the construction of the avenue and bridge, completed for travel, and $440,000 for land damages.

A MAN ON THE COW CATCHER.

"The time is not far off when every locomotive drawing a passenger train on every busy railroad will have a pilot. This pilot will have no more to do with the engine itself than the pilot of a ferry-boat. His duty will be to simply look ahead and communicate with the engineer in the cab." The man who uttered this prophecy was not a sentimentalist, but a very busy, practical railroad man, in charge of twice as many, if not three times as many trains as any other man on the Atlantic coast.

"The pace has been rapidly getting hotter and hotter in railroading," he continued, "until every improvement the human mind can suggest is adopted as fast as it is thought of, and the big roads are like so many sets of the most perfectly adjusted clockwork. Every device for switching, signalling, ballasting, taking water or coal, and, above all, making speed, is the subject of constant study and improvement, two things being kept in view always and in all things—saving time and preventing accident. Between New York and the big cities within a few hours' ride of it the tracks are dotted with trains running like mad. If there is the least flaw in anything—engine, cars, tracks, switches, signals, time-tables, or what not—there is likely to be a smash up. So much time and money are spent in guarding against the possibility of accident that serious ones are very rare. But in the midst of all this race for perfection the engineer is as he was at first. He is unimproved. He is only a man, and the best man can only do so much. An engineer was all that was wanted a few years ago, but now it is different. The engineer of to-day has got more than he can do. Somebody must ease him of some of his load."

"So," continued the railroad man, "I predict that every passenger locomotive will soon carry a pilot. I don't know where he will be—whether on the cab or in front of the cab over the boiler, or in front of the boiler over what we now call the pilot and you call the cow-catcher, but he will be carried on every locomotive that carries trains at a high rate of speed, and he will watch the signals, switches, bridges, highways and junctions, and do nothing else, while the engineer runs his engine.

"As it is, the engineer may be trying his water-gauge just when he should be looking at a signal. There are half a hundred necessary things he may be doing that will take his eyes off the road for an instant. He will miss a signal; and a wreck will be the result. Mind, I don't say what has happened. I am not going to tell any tales out of school. I only say it will happen."

"Don't the firemen on fast trains get into the way of helping their engineers more and more as time goes on?"

"No. They, too, have all they can do. The faster the train the more they have to work. Nothing can be looked for from them. The only thing is, as I tell you, a third man in a little house of his own ahead of or over the engineer, with a bell rope communicating with a gong in the cab. You'll see him there in a very few years."

THE Tehuantepec Railroad Company having forfeited its charter, the Mexican government will complete the road, the work being done under the direction of General Diaz.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.
Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR............ASSOCIATE EDITOR.

SATURDAY, AUGUST 19, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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VAN NOSTRAND has issued, as Nos. 59 and 60 of his Science Series, S. W. Robinson's papers on Railroad Economics and Strength of Wrought Iron Bridges.

IN the last number of the Pi Eta Scientific Society of Rensselaer Polytechnic Society, of Troy, N. Y., Geo. H. Ennis writes on manufacture of paper, Wm. J. Bates, C. E., describes Chicago from an Engineering Point of View, and P. H. Baermann, C. E., describes in an illustrated paper the Manufacture and Use of Cast-Iron Pipes. This really valuable publication is for sale by the Secretary at Troy, N. Y.

TWELVE copies of "Greene's Bridge Trusses" remain unsold. The price is 60 cents per copy, which may be remitted in postage stamps and unregistered. These few copies will close out the original edition of this popular and valuable bridge treatise. The price of the enlarged edition is $2.50, and practically the cheap edition which we are selling is as valuable as the more costly one. Only twelve more orders can be filled; after that the money will be returned.

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RECENT SCIENTIFIC DISCOVERIES.

The Annual Report of the Regents of the Smithsonian Institute for the year 1880, has just been distributed. It is full of very valuable and interesting scientific memoranda and papers, collated from scientific journals or contributed by individuals. The Bibliography of Sir William Herschel's scientific writings occupies 114 pages, as condensed by Prof. E. S. Holden and Dr. Chas. S. Hastings; "An Account of Investigations Relative to Illuminating Materials," by Joseph Henry, is reprinted from the Report of the U. S. Light-house Board for 1875, so great is the scientific value attached to the memoir, by Prof. S. F. Baird, Secretary of the Institution; Barometric Observations of Prof. E. S. Snell, of Amherst College, are discussed by Prof. F. H. Loud, of Colorado College, and an illustrated description of Luray Cavern, in Page Co., Virginia, is given at some length.

From the many pages of scientific memoranda we cull a few notes which we think will be of interest to our readers. From observations of Mars, made at Ascension Island in 1877, Mr. Gill finds the solar parallax to be 8".78. At the same opposition Mr. Maxwell Hall, in Jamaica, with an equatorial of 4 inches aperture, made the parallax 8".79. Master A. A. Nichelson, U. S. N., at his own expense, conducted a series of experiments on the velocity of light, resulting in determining the velocity to be 186,380 miles per second. Prof. Pickering in 1880 undertook to determine the light of all the stars visible to the naked eye at Cambridge, Mass. The stars are observed in the meridian. The photometer consists of a horizontal telescope, pointing to the west, and having two objectives. By means of two prisms mounted in front of the telescope, the pole-star is reflected into one object-glass, and the star to be measured into the other. The cones of light are made to coincide by a double-image prism, the extra images being cut off by an eye-stop. The star to be measured is thus seen in the same field with the pole-star, under exactly the same conditions. To determine the relative transparency of the air at different altitudes, a list of a hundred circum-polar stars has been prepared, to be observed at both upper and lower culminations. Progressive changes in the light of the pole-star may thus also be detected and eliminated.

Great activity has been manifested in physics during the years 1879–80. New and important discoveries have been made, improved modes of research have been devised, greater accuracy has been attained in measures of precision, and more uniform and precise standards have been adopted as units. Sainte-Claire Deville and Mascart communicated to the International Geodetic Association an elaborate paper, describing the construction and giving the properties of the new platinum-iridium standard of length. The alloy was made by Johnson, Matthey & Co., by fusing together 450 ounces of platinum and 55 ounces iridium. After suitable working it was drawn through a draw-plate into a bar accurately rectangular in cross section. Its density was now 21.51, and it was found to contain platinum 89.41, iridium 10.19, rhodium 0.17, rutheninm 0.10, iron 0.06. This alloy is harder and more resistant than platinum, is much more rigid, and has a high elasticity, its modulus being 21,912,000,000, and its elongation-coefficient, 0.0008. Its coefficient of expansion was in course of determination by Mascart, the elaborate preliminary measurements only being described.

C. S. Pierce has reported progress in the comparison of a wave-length with a meter. Using a Rutherford ruled plate of 340½ lines to a millimeter, three complete measures of Van der Willigen's spectrum line No. 16 gave for the angle of double deviation as a mean, 89° 54' 19".5. An error of 0.4" would make an error of a micron in the length of the meter. Subsequently, another line near the former one was selected, and a finer plate was used. As a mean of six closely accordant measures, the double deviation was 90° 08' 51".45. One of these plates had been compared with all the centimeters of a decimeter scale. The other is to be compared with the even two centimeters of the same scale. This decimeter scale was in progress of comparison by Mr. Chapman with the decimeters of a meter scale. When done, a meter will have been compared with a wave length.

Herschel has published a paper on the use of the seconds pendulum for determining the figure of the earth, in which he comes to the conclusion that the experiments made hitherto are of little use, since the problem to be solved was so imperfectly grasped. The use of the absolute pendulum contemplated two distinct objects, which had no essential connection, the force of gravity and the figure of the earth; while the use of the differential pendulum contemplated only one.

The rate of the second's pendulum varies along the actual equator, and the value of gravity at the equator is therefore only an idea.

C. S. Peirce has given the results of his pendulum experiments, made under the direction of the Coast Survey.

The values obtained were:

At Hoboken, 0.9932053 m. At Paris, 0.9939337. At Berlin, 0.9942399. At Kew, 0.9941776. Reduced to the Sea level, these numbers become:

0.9933074, 0.9939500, 0.9942482, and 0.9941790.

Reduced to the equator, they are:

0.9910003, 0.9910132, 0.9909865, and 0.9910098.

These values, the author thinks, will have to be diminished by about twenty microns, on account of the error of the standard of length employed.

Mendenhall has made a series of experiments to determine the force of gravity at Tokio, Japan.

In the earlier part of the investigation, a Kater pendulum was used; in the latter, one of Borda's construction. The beats were recorded upon a chronograph at the same time with those of a break-circuit clock, the length of one second upon a sheet being about 8 mm., so that it could easily be subdivided.

Since it was only the fractional part of a second by which the two pendulums differed that was to be determined, the standard pendulum was only required to break the circuit twice, once at the beginning and again at the end of the experiment.

As a mean of six experiments with the Kater pendulum the value of "g" was found to be 9.7974; the mean of eleven experiments with the Borda pendulum gave 9.7984.

Edison's carbon filaments are constructed by cutting with a suitable punch from a piece of Bristol-board a strip in the form of a miniature horseshoe about 2 in. in length, and one-sixteenth of an inch in width.

These are laid in a wrought-iron mould, separated from each other by tissue paper, and heated first by a gas flame and then in a furnace to a white heat. After cooling, the charred fibre is sealed in a globe, which is then exhausted to one-millionth of an atmosphere. Subsequently, in experimenting with various fibres, Edison came to the conclusion that a natural fibre was more durable than an artificial one, and that Japanese bamboo furnished the best. The lamps which are made on the large scale are constructed with these fibres.

◆

THE IRON TRADE.

The American iron trade has passed successfully through a summer which was threatened with more than ordinary dangers. The strike, which set ten thousand puddling furnaces idle on June 1, still continues, and despite reports to the contrary, is likely to continue for weeks to come. The Amalgamated Association is strong, and when it proclaimed war ten weeks ago knew a three to five months' contest was probable. The Association violated its pledged word in striking and has forfeited the respect which it claims. No terms of peace are probable. The manufacturers chafe under the arbitrary dictation of unionism which at the least occasion stalks into the office or counting-room with demands which, unless granted, will shut down the dampers in an hour.

While the men are surprised at the determination of their employers, they are by no means disheartened, and expect to be aided by an active fall demand which will drive the idle mills into an unwilling resumption. The price of iron and steel has been stationary since June 1. This is unusual. It shows that but for the strike prices would have declined, possibly to limits which would close a number of mills. The danger now is that if mills do start, the resulting abundance of iron will, in a short time, a few months at most, overstock the market and reduce prices to a minimum. This is all right for consumers who have been paying for a long time prices fixed by unfavorable market conditions.

The general outlook is favorable to an active fall trade in all Eastern and Western markets. Demand is steady and prices firm. The strike will continue until the strikers get tired.

Bar iron is selling at 2½ to 2$\frac{6}{10}$ in Eastern markets, and 2¾ to 3 in Western centres. Nails are kept down by sellers to $3.40 at mill. Stocks are very light and speculative inquiry is abroad, seeking to get control of stocks, and advance the market. Manufacturers have fallen into the same trap before, and are very careful to supply only actual customers.

Pig iron is firm in eastern markets, because of the blowing out of quite a number of furnaces. No. 1 Foundry sells at $26, No. 2, $24, Gray Forge, $22–$23, Bessemer, $25, Muck bar, $42–$43, Steel Rails, $47–$50, Iron Rails, $45–$48, Old Rails, $26-

$27. All individual establishments East are actively engaged on orders in hand, or in making up stocks which will be called on in a short time. Railroad building has not been renewed on a large scale, because of the existence of several causes of uncertainty, but the opportunity is waited for to invest millions. The mileage so far is not far from 5,700 miles for the year, and at the present rate of progress 10,000 miles will be exceeded before the close of the year. No large contracts have been made recently. When the heavy crops are moved it is expected that several half completed roads will be hurried to completion. The delay has been due partly to the uncertainty as to the magnitude of the crops. Another element of uncertainty has been the labor troubles. The establishment of peace between the trunk lines, the increase of rates and the improving volume of traffic are all favorable indications for those interested in the iron and steel industry. No upward tendency in prices can long exist, as the productive capacity has reached limits which will provide for all probable consumptive requirements.

PERSONAL.

William F. Ellis, of Boston, chief engineer of the Connotton Valley (N. G.) railroad, has resigned.

H. G. White, C. E., Towne Scientific School, '82, was appointed assistant to F. H. Lewis, Inspecter of Track, Buildings and Bridges, N. P. R. R., with headquarters at St. Paul, Minn.

First-Lieutenant Thomas L. Casey, Jr., Engineer Corps, has been detailed by the Secretary of War to accompany Professor Newcomb's party to the Cape of Good Hope to make observations of the transit of Venus.

Jesse Hoyt, one of the most widely known grain and flour merchants of this city, died on the 14th at his home, 51 West Forty-eighth street, in the 68th year of his age. Mr. Hoyt is also well known as a builder of grain elevators. Two years ago he built the mammoth elevator at the Erie Railroad terminus in Jersey City. With Angus Smith he built the first grain elevator put up in Milwaukee. This one, with two others that he built there, was afterward sold to what is now the Chicago, Milwaukee & St. Paul Railroad. He built three more elevators at Milwaukee, which he sold to the Chicago & Northwestern Railroad. More recently he had built a number of elevators in Chicago in the interests of both of the railroads mentioned. He was also largely interested in railways, principally in Illinois and Michigan. His fortune is estimated at several millions.

A leading journal of Madrid states that the father of Arabi Pasha was a maker of wooden cases in which dried raisins were kept at Barcelona. Arabi was brought up to his father's trade, according to this account, but, manifesting a love of reading, was sent to the University of Valencia, where for four years he studied law. But he abandoned his legal studies and became a chorus singer. After this escapade he was next heard of in Morocco, in a regiment of lancers, in which he had enlisted in 1859, and received for his bravery three decorations and a commission as Lieutenant. Falling in love, after the evacuation of Tetuan, with the daughter of a rich Jewish merchant, he deserted from the Spanish army and took refuge on an English merchant vessel, which was shipwrecked in the Straits of Bab-el-Mandeb. Arabi escaped, and after some wandering in Abyssinia and Nubia, settled in Egypt, became a Mohammedan, and studied the Moslem law.

Gen. James H. Ledlie died on the 15th, at St. Mark's Hotel, New Brighton, Staten Island, of dropsy and jaundice, after a brief illness. He was about 50 years old and a native of Utica. He graduated from the Scientific Department of Union College, and soon after was made a Division Engineer on the Erie Canal. At a later period he took the contract of the Seneca River Improvement Company for draining the marshes near Geneva, in this State. At the beginning of the civil war he joined the Army of the Potomac as Major of the Nineteenth New York Volunteers. Subsequently he was made a Colonel, and at the battle of Fredericksburg he commanded a brigade. After the battle he was promoted to Brigadier-General of Volunteers. During the greater part of 1863 he was Chief of Ordnance at Norfolk, Va., and he commanded the military in this city at the outbreak of the riots in 1863, but was superseded by General Butler. After the war he returned to the practice of his profession, and was the first person to demonstrate the practicability of taking rafts from the lumber regions across Lake Michigan to Chicago. Later he obtained and carried out the contract for the construction of bridges, trestles, and snow-sheds along the entire line of the Union Pacific Railway. After completing that work he built the breakwater in Chicago Harbor, and did some railroad engineering work in Georgia. He next visited Europe, and after his return, in 1879, he built the Nevada Central Railroad from Austin to Battle Mountain. He was when he died President of the Baltimore, Cincinnati & Western Railroad Construction Company, and First Vice-President of the railroad company; also Chief Engineer and General Manager of the Santa Rosa & Sonoma Central Railroad of California, Chief Engineer of the Nevada Southern Railroad, and largely interested in the Indian River Railroad of Florida.

THE RIVER AND HARBOR BILL.

Senator George F. Hoar, of Massachusetts, has addressed to that State a letter containing about 7,500 words, for the purpose of explaining his vote in favor of the River and Harbor bill, and his second vote for the same bill when it was passed over the President's veto. He says: "No representative of Massachusetts could have had the slightest personal motive to do other than his simple duty in the matter. The bill contained only the moderate appropriation of $371,000 to be expended within her limits, and this for objects so clearly just and reasonable that they would have kept their place if the bill had been reduced by two-thirds. If we have erred, it has been with the sincerest desire to do right and without the smallest motive to do wrong. I expect to satisfy you that we were governed by grave, honest, sound, Republican, Massachusetts reasons. In one thing, at least, you will agree with me. Being convinced by these reasons myself, if I had failed to act upon that conviction from any fear of personal consequences, I should have been unworthy of you and unworthy the respect of honest men. There is no son of Massachusetts who loves her more than I do. But fully believing, after careful consideration, that my duty to her and to the whole country required of me that vote, I could not have failed to cast it for all the honors and offices within her gift.

"What is this River and Harbor bill which has been the subject of such criticism? It appropriates $18,738,875. But of this sum, $5,368,500 are for the special improvement of the Mississippi River, according to the design of an eminent commission specially appointed in a former year to frame a plan for that purpose; $400,000 for the reclamation of the malarial and pestiferous flats near the White House, and $247,500 are for future surveys. To neither of these items, so far as I can learn, is there objection anywhere.

* * * * *

"Deducting these three extraordinary items, each of which might properly have been in a separate bill, there remain $12,722,875 as the subject of discussion. The expenditure of last year was $11,451,300.

"Further, of this whole sum of $12,700,000 there is but $1,333,475 that is new. All the rest is for public improvements partially completed, most of which have been going on for years, many of them under contracts, and all, or nearly all, if abandoned, will cause the loss of all the money previously expended.

* * * * *

"Let us turn our attention to the $5,400,000 to be expended on the interior waterways of the country other than the Mississippi and the Missouri. It is against this that the artillery of denunciation has been chiefly directed.

* * * * *

"Taking the movements of merchandise by waterways and landways other than by rail into account, the domestic produce moved and exchanged in this country must be, at least, between $30,000,000,000 and $40,000,000,000 in value, or more than forty times the value of our exports. The river commerce of the single city of Cincinnati was last year more than $45,000,000. There passes each year up and down Detroit River a tonnage greater than enters Liverpool. The number of vessels that go in and out of Chicago annually exceeds by 7,000 those of New York; and although these vessels are, of course, smaller in size, the actual tonnage of Chicago is much more than half that of New York. These waterways are not only of vast importance in themselves, but they are important also as a check upon the prices charged by the railroads. They are free. When the waterway is once fitted for transport it is the property of all mankind.

* * * * * *

"Railroad competition terminates in railroad combination. The only check on the power of the great railroad lines, when in concert, over the commerce of the Nation is the competition of the waterway. When the Erie Canal and the harbors of the lakes freeze in the winter, up go the freights. When canal, lake, and river open in the spring, down go the freights. I do not and cannot overstate the importance of this consideration to the American people, and more especially to Massachusetts. The diminution of the price of freight on the railroads of this country, 1 mill a ton a mile, makes an annual saving to the people of $70,000,000. Great as is the interest of the South and West in domestic commerce and transportation, it is not so great as that of Massachusetts. She manufactures nearly one thousand millions in value every year. Of this I am justified, by the opinion of a business man of large experience, in saying not one-fiftieth is sent beyond sea. The rest goes all over the land by river and rail and lake, to be distributed in the West and South, whence come her food and her iron and coal and wool and hides and cotton. Every obstruction removed from the channel in a Western river, every sunken rock blown out from a lake harbor, every creek or inlet by which a navigable stream reaches its arms into the midst of wheat fields or cotton plantations, is an obstacle the less in the way of the food to the mouths of her workmen, in the way of the material which their cunning fingers are to change into products of use and beauty, in the way of the sale of her manufactures to the customers on whom her wealth is to depend.

* * * * * * *

"This item of five millions of dollars is the expenditure of this year for that policy of internal improvement for which our earlier statesmen labored. It has been a Massachusetts doctrine since the days of Webster, and a Republican doctrine since the first great speech of Sumner.

* * * * * * *

"*The people get more for their money from this class of appropriations than from any other. These works are permanent. They do not perish with the using. The money is expended by the Board of Engineers. This board is made up of experienced Army officers, and has the confidence of the country more than any other public body, not excepting the Supreme Court itself. No member of Congress or anybody else can influence a dollar of the expenditure. The economy and honesty of the expenditure of no dollar in this department has ever, so far as I know, been challenged.*

* * * * * *

"The Constitution authorizes these expenditures only when the advantage received by the public repays the cost, and when that advantage is advantage to commerce with foreign nations or among the States. If the expenditure be wasteful, or if it be merely for individual or local benefit, it is to be condemned. But it does not follow from this statement that because a harbor or a waterway is within the limits of one State, or county, or town, it is for that reason local only. If the effect of the public work be to annex that community to the great system of national or international ways, and that community be of sufficient importance, or will be by the improvement made of sufficient importance, to make that annexation a national benefit, then the expenditure is warranted.

* * * * * * *

"But, it is said, when the President vetoed the bill, expressing his opinion that it contained unconstitutional provisions, and provisions entirely for the benefit of particular localities, you ought to have surrendered yours. I do not so read that constitutional mandate which I am sworn to obey.

* * * * * *

"But the duty of the Senator or Representative, when the President returns a bill with his objections, to vote on its reconsideration according to his own conscience is as clearly set forth in the Constitution as the duty of the President to act according to his.

"The President did not point out any item which he thought of local interest only, and did not point out any instance in which he thought the bill unconstitutional. He did not refer us to the information on which he acted, that we might see whether it were he or we that were deceived. We were, therefore, left to our own resources. If the bill failed, all public works of this class must stop. The suggestion that a general appropriation should be made of half the sum provided in the bill, with authority to the President to expend it on such public works as he thought fit, seems to me, with due respect, totally inadmissible.

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"The public is perfectly protected. The money is to be expended by an executive department, subordinate to the President. If there be an unconstitutional provision in it, it is not only in his power, but it will be his duty, not to carry that provision into effect. This bill is not like the ordinary appropriation bills, under which the money is to be spent within the year. There is no limit or enactment as to the time within which the work shall be done. If the President shall be satisfied, on full inquiry, in regard to any single item, that it is unconstitutional, or not of public national importance, he can direct the Secretary of War to postpone the work until he can communicate the facts to Congress for further consideration.

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"I have, since my return to Massachusetts, gone over the new items of this bill except five small ones, the reports in regard to which are not at hand. I believe every one of them to be warranted and constitutional within Mr. Webster's definition. I believe there is not an intelligent business man in Massachusetts who, if he will sit down with me at a table and make the examination, will not come to the same conclusion if he believe Mr. Webster's doctrine.

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"If there be a single item in this bill placed there for an object not public and national, but private and local only, let it and those who voted for it be condemned. If in one single line it were framed so that votes for one provision might be purchased by votes for another, or the public money expended for private objects that legislators might gain personal or political advantage, let it be abhorred as tainted all through. But I confidently challenge the fullest criticism and discussion of this issue. The new provisions of the bill are fifty-seven in number. I gave above a list of fifteen of them, amounting to $847,000. The remaining forty-two are most of them for smaller amounts. I have carefully gone over them with the Engineer's reports, item by item, except in five cases, where special reports were sent the extra session of the Senate, and are not here. I declare my confident belief that there is not one of them that would not receive your vote, or that would not receive the votes of the most honest and zealous of those who have hastily and ignorantly denounced this measure, if he were to vote on it by itself.

"It is said that the bill is made up and carried by a vast system of log-rolling, by which the votes of members are obtained for the bill by inserting in it provisions for the worthless and useless jobs in their own districts. To what member from Massachusetts is this charge directed? I have never had the least reason to believe that the provision for any public work in Massachusetts depended on the opinions or purposes of any of her representatives in regard to the entire measure.

"The accusation is infinitely degrading and insulting; not only to Congress, but to the American people itself. That people must be reduced to a low grade, both in intelligence and morals, whose representatives seek to win their favor by spending the public money for private or local jobs.

The very nature of the bill makes this thing an impossibility. The engineers reported that some $37,000,000 could be profitably expended this year. This does not include the sum recommended by the Mississippi Commission. In reducing this to $13,000,000 the committee were compelled to postpone many works of merit. The introduction of any worthless job must at once excite the antagonism of every man who had in his care the interest of a really worthy work which was excluded. The American people are not blind to their business interests.

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"There is one respect in which this river and harbor money is the best spent of all public appropriations, save only the pensions. There are vast spaces in this country where the United States government has been known for a generation only in the character of a conqueror or a tax-gatherer. It is good that they should see this great and beneficent power in its character of benefactor. Almost all the forces there are centrifugal. The United States is represented by a dozen Congressmen and Senators, by a District Judge and Marshal, and by the local postmaster, and that is all. The State has its governor, its judges, its executive departments, its numerous legislature, its state, county and town officers, wielding every important instrumentality of government. All these are interested in supporting the dignity and enhancing the authority of the state. This is well. It is the peculiar glory and security of American institutions. But it is also well that the people in those sections of the country who have been educated for half a century to look on the national government with jealousy and dislike, and who have felt its terrible power in war, in wasted fields and desolated homes, should learn to associate its image with the beneficent works which join them with the great system of national commerce, and on which their prosperity and wealth are hereafter to depend."

HOW RAILROAD MEN TIME TRAINS.

A DEVICE FOR SUPPLYING A TIME TABLE READY MADE FOR EXTRA AND IRREGULAR TRAINS.

Every railroad issues two time tables whenever the running time of trains is changed—one table for the public and one for the guidance of engineers and trainmen. The main difference between the two is that the schedule for the employés contains the time of every train at every station on its route, whereas the schedule for the public only gives the time at places where the trains stop. Dots and daggers and letters alongside of the time figures explain to the engineer and conductor at what points and why he is to stop. The absence of these show that the train is not to stop at all. There is naturally nothing about the conduct of a railroad on which more time and care are spent than these time tables, and the growth of railroading between the period not many years ago, when the Philadelphia Express was held at Newark or elsewhere for some regular passenger who had been belated, and the present time, when trains that run distances of 500 miles can be relied on to be at any point on their route on schedule time, is shown most clearly in the equal growth of the time table. The half minute appears for the first time in the schedule about to be issued for the New York Division of the Pennsylvania Railroad. Minutes had been fine enough divisions of time before. It is explained that the half minute has forced itself into recognition. Modern railroading is so fast, stations have grown so close together, and the movement of trains has become so regular, that this fine division of time not only can be but has to be made. Nothing greater than half a minute will apply to a train running at the rate of 60 miles an hour between New Brunswick and East Brunswick stations, which are just half a mile apart.

The time table in question has many other new features. It is to govern the movements of 228 passenger trains every day. It is no longer an unhandy chart, three feet long by two feet wide, like its predecessors, but a thin, narrow book, such as some other railroads long ago saw the wisdom of issuing. Its novel features are that its type is kept standing, and when any train's time is changed, instead of the change being published, as has always been done, on a separate sheet, apt to be mislaid or lost, the page in which it occurs will be corrected and reprinted, to be pasted into all the books by a man whose special duty that will be, and who will stamp the back of each corrected book before returning it. The Sunday trains are on yellow leaves, to distinguish them from the others, which are on white paper. Bound with the time-table, is a collection of diagrams, showing the position of the tracks and signals at the principal junctions and points where the switches are complicated. It is said that engineers learn by heart the switches on certain tracks upon which they are accustomed to run, and master thoroughly the switches governing those; but they are thoroughly at sea when, by reason of a blockade caused by a wreck or other irregularity, they receive telegraphic orders to take some track they are not used to. The diagrams give them the fullest information by means of a picture which admits of no misunderstanding.

The copyrighted speed schedules, which are also bound in the same covers, form a wholly new departure in railroad methods. They were designed to govern the movements of extra and irregular trains sent out at a moment's notice, and to be run at almost any given rate of speed. This portion of one of them shows what all are like:

Distance.	Stations.	Distance.	Average rate of speed per hour, 60 miles. West bound.	Average rate of speed per hour, 60 miles. East bound.
....	Jersey City	89.66	....	1.30
2.47	Marion	87.19	3	1.27
3.67	Meadows	85.99	4½	1.25½
7.03	East Newark	82.63	7½	1.22½
..	Centre street, Newark	82.13	...	...
7.93	Market street, Newark	81.73	8½	1.21½
8.46	Chestnut street, Newark	81.20	....	....
9.25	Emmett street, Newark	80.41	10	1.20
10.58	Waverly	79.08	11	1.18½
12.27	North Elizabeth	77.39	12½	1.17
13.25	Elizabeth	76.41	14	1.16

The first column shows the distances from Jersey City and the third column the distances backward from Philadelphia. If, as is often the case, a special train to Philadelphia is ordered from Jersey City to make sixty miles an hour, the engineer, by means of the above schedule, knows that he must get to Marion in 3 minutes, to East Newark in 7½ minutes, to Waverly in 11 minutes, to Elizabeth in 14 minutes, and so on. These schedules are not drawn to a table of miles, but are practical, and are adjusted in accordance with the changing peculiarities of the road. In the above example, for instance, allowance is made for two draw-bridges between Jersey City and Newark, and the lost time is only partly recovered on the straight, unbroken track between Newark and Elizabeth. This is the case wherever curves, junctions, highways, grades and bridges are apt to cause delay. At such points a margin is left in the schedule, whereas there is none in such parts of the road as that between New Brunswick and Trenton, where there are long stretches of straight track, "and," as Trainmaster Charles Watts, the inventor of the new schedule, expressed it, "trains might as well be run eighty miles an hour as sixty." There is a schedule for each direction, because where there is an up-grade and a loss of time going one way, there is a down-grade and a gain returning.

Heretofore when a special train was to start, a calculation of about what speed it was to run at was made, according as the condition of the road at the time warranted. If it was at night, when the road is lined with freight trains, a high rate of speed was not considered as safe as in the daytime, but whenever it was, the engineer received his orders to run at the rate determined upon. If he happened to be a very intelligent and self-possessed man, used to irregular performances, he would keep up an even rate of speed, but the chances are great he would run like lightning half the time, then loaf the rest of the way. In all cases, the fact that he was coming would have been telegraphed ahead all over the line, and every freight engineer would be uneasy and anxious to seek a siding until the extra rumbled by and the danger was past. The signalmen and the operators in the dispatcher's office were also on tenterhooks trying to determine his whereabouts and the time of his arrival at points ahead. Now, with the new schedule, all are to be informed that an extra leaving at such a time will run at such a rate, and every man interested can satisfy himself by a reference to the tables just where the extra is or will be at any given moment. In cases where a train from the West is behindhand two, three or four hours, as is sometimes the case when a wreck blocks the road, it is to be annulled by telegraph. The schedule is to be of use again in governing trains run as second sections of regular trains. Now they are indicated by a flag carried ahead of the engine of the regular, but that entails their being run on the same time, which may be faster than is necessary. Hereafter they will be run on one of the new schedules, and announced ahead over the wires. Railroad men who have considered this invention say that it is a wonder that a railroad could ever have been run without it. A railroad man who was trying to think up all the possible uses of the new schedule, said that there is a millionaire cattle dealer in Princeton who frequently orders a special train, as well as a young New Yorker who engages one whenever he is on a lark.

"He always has a friend with him," said he, and he seems to think that the thing to do is to have a train all to himself. The other day he came—it was the third or fourth time—and said he wanted to go to Philadelphia as quick as possible. He was told it would cost him $150. We said he could have a car all to himself to any point in any regular train for eighteen regular fares, but he wanted a train and didn't mind the expense. He started at sixty miles an hour. When he got to Trenton he called in the conductor, and told him he had been trying to think why he had wanted to go to Philadelphia, and could not make out why it was. He said he thought he'd go back to New York. In that case the new schedule would have been a blessing.—*N. Y. Sun.*

THE WAR IN EGYPT, AND ENGINEERS.

There are strong indications that the forthcoming operations will constitute an engineering campaign, partly owing to the periodical overflow of the Nile, whose waters will be out about the period when active operations can be begun. The Franco-Prussian war of 1870-'71 was largely an "Intelligence Department" campaign. The Russo-Turkish war may be said to have been a "pick and spade" and "tactical" campaign, there having been but little strategy, and still less of railway operation. The Prussian Intelligence Department had been preparing for the war of 1870-'71 for eight years. This astute and highly organized department, during all this time, had its employés all over France under various pretexts and in various disguises. These able officers mapped out every line of railway throughout the country, including every branch line, and they prepared reports and notes of the amount of rolling stock of every description. They knew the strategic and tactical value of every railway station in the empire, large or small; they were perfectly familiar with the characteristics and value of every line that went near important positions or strategic points of value. Every highway and bye-road, even every lane, was accurately mapped out; all towns, villages and hamlets, with their relative values as strategic or tactical positions, were recorded. The maps and information thus patiently gathered were carefully compared with the French staff-maps and other official documents, and corrected where necessary. They were then engraved on a small scale, and printed in many thousands ready for distribution to every commanding or staff officer as soon as war was imminent between the two countries. Even the resources of France for food supply were fully tabulated, so that requisitions on the inhabitants might be enforced. The railway time-tables for the dispatch of Prussian troops to the French frontier were compiled at the Intelligence Department, all having been carefully prepared and placed ready for immediate use. When the war broke out, the Prussian troops were rapidly taken to and massed opposite the French positions at Forbach and Woerth. The Prussians vigorously attacked, and in a few days the world saw the most astounding feat of arms which it has ever witnessed, and a powerful nation was struck down at the feet of its conqueror. This campaign was indeed a grand lesson in the art of war, and its influence has been great upon the military systems of every European power, including that of Great Britain, for it caused this country largely to reorganize her whole military administration. Now is the first occasion that this new organization has been put to a practical test on an extensive scale.

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Engineering operations will play a highly important part in the coming campaign in Egypt, and events will doubtless illustrate strikingly the strategic value of railways in warlike movements. An elaborate and well-designed rolling stock and appliances for repairs has been prepared and shipped ready for transport, including several powerful locomotives, complete in every detail for immediate use. Major Wallace, R. E., an officer of great experience in the construction and management of railways, commands this portion of the expedition. This officer has had entire charge for some years of an extensive railway district in India, and he is well versed in every detail requisite for railway operations during war. Captain Scott, R. E., is second in charge. He is an officer of experience in traffic management and in practical details of railway construction and working. Captain Sidney Smith commands the Royal Engineer Railway Company, as it will be called. The remaining officers are young men who have just joined the corps from the Royal Military Academy at Woolwich. Their names are Lieutenant Vidal, Lieutenant Huleat, and Lieutenant Dopping Hepensthal; a fine opportunity for distinguishing themselves is now before them. The whole staff, officers and men alike, have been for some time past attached to trains running on the London, Chatham & Dover and the Southwestern Railways, where they have learned very valuable experience in railway work.

The Canada steamship, lying at the T pier at Woolwich Arsenal, is completely loaded with the equipment of the Royal Engineer Railway staff, who go out in this vessel; a wise arrangement, since the staff itself will superintend the unloading of the cargo, and will be under a final course of instruction on the way out. Timber, steel rails, switches, points, pot sleepers, and every requisite for the repair of lines broken up, and material for the repair of bridges, are on board the Canada, as well as an ample supply of tools of every nature. Steel-faced bullet-proof mantlets for working parties in trucks, or on the permanent way, have been supplied. Indeed, nothing seems to have been forgotten, and the state of this portion of the expedition gives a good augury for successful service—service that will doubtless enhance the already high reputation of the corps. A pontooning company has been formed at Aldershot, with a full supply of pontoons for crossing rivers and other water-courses. A telegraph company has also been organized, replete with every appliance of telegraphy in all its branches. The officers belonging to this company are constructive and working telegraphists, and the men have all passed examinations in every department of this science. Major Armstrong, R. E., a well-known officer, has rendered his valuable assistance towards the formation and equipment of this company.

The Royal Engineers, as the scientific corps of the British Army, will doubtless achieve the full measure of success they deserve, and it is not too much to say that the success of the campaign will depend chiefly on their efforts.—*Engineering.*

Hawaiian Islands.—Hawaiian advices are to July 31: The Gibson ministry have carried all their measures. A $2,000,000 loan at six per cent., without government taxes; $1,500,000 for internal improvements, and $500,000 for immigration.

The largest diamond-cutting house is in Amsterdam, employing 400 persons, where the Koh-i-noor was cut. The trade is difficult, and the wages are from $7 to $12 or even $14 per day.

THE ISTHMUS CANAL.

WHAT HAS BEEN DONE AND WHAT IS BEING DONE BY THE ENGINEERS.

Operations in connection with the projected Panama Canal have for some time past been principally directed to the completion of the surveys along the line of the canal. This work, though prosecuted with all possible dispatch, has met with considerable vexatious delay in endeavoring to materially reduce the excavations after the central line of the canal shall be determined. With this end in view, the regular engineer corps has been divided into exploring parties, each having its designated locality for a field of operations. The instructions invariably received are to ascertain the topography of the country along the main line of the canal as at present decided upon, note carefully the different acclivities encountered in the immediate vicinity, and their adaptability for stations. On the conclusion of these researches a report is submitted to the Executive Board at Panama, and by the comparison which is instituted a line is reached as a basis for future operations. Under the direction of Pedro Sosa, a prominent Colombian engineer, excellent results have been arrived at, so that the excavations originally proposed have been materially reduced.

THE CENTRAL LINE.

In an interview with Jeronimo Ossa, a member of the engineer corps in Panama, and who arrived in this city by the last steamer, it was ascertained that the surveying had been finished, and that attention is now concentrated upon determining the center of the canal. The route of the canal has already been cleared of trees, and with the above exception everything is in readiness for the excavation to commence. In fact, a contract has already been given to excavate a distance of eight miles, from Colon to Gatum, and it is expected that work will be commenced on November 1st. The machinery to be used in this work is in progress of construction, some of it awaiting shipment from this city to New York.

DAMMING THE CHAGRES.

The most important labor, that of erecting a dam at Gamboa on the Chagres River, engrosses the attention of the engineers. Over sixty kilometers of the river have been explored, and its affluents and currents studied. In another direction tracks have been laid for the purpose of carrying the excavated earth and stones to the proposed site of the dam, while along the whole route of the canal, from Colon to Panama, stations have been established. A large number of warehouses have also been built. A commodious hospital has been constructed upon an eminence in Panama for the benefit of the canal company's employés and placed under the direction of competent physicians. An additional contract to that cited above has been given for excavation of 87,000 cubic meters at Obispo, where a large warehouse will be built, as well as additional shops to those already erected. It is now definitely settled that the canal will be completed within the time originally assigned.

Passing from the recent developments, Senor Ossa stated that business in Panama, under the influence of the general activity along the line of the canal, had largely increased, and that the laboring classes experienced no lack of employment.—*San Francisco Chronicle.*

THE COAST SURVEY IN CALIFORNIA.

THE WORK TO BE PROSECUTED UNDER THE NEW APPROPRIATION.

The tardiness with which Congress passed the bill making the necessary appropriation for the continuance of the work of the United States Coast and Geodetic Survey, has delayed the field work considerably. Professor Davidson himself went to Washington to urge the bill's passage, and, having been successful, he has just returned. The amount of the appropriation for the Pacific coast is $170,000, this being $10,000 less than that of previous seasons. The Committee on Appropriations refused to report in favor of $100,000 additional, to be used in the construction of a vessel for the survey of the coast of Alaska, so that this important branch of the work has to be deferred another year.

Several important operations, however, have been carried on during the summer, despite the absent aid of an appropriation, under the direction of Superintendent Hilgard, such as the re-survey of the improvements of San Francisco Bay, by Assistant Langteller; the establishment of a permanent magnetic observatory at Los Angeles, by Assistant Lawson; the survey of dangerous channels in the Alexander Archipelago of Alaska, by Commander Nichols, and the topography and triangulation of the Columbia River, by Assistant Rockwell.

As far as can be learned the general assignment of field parties is as follows: Professor Davidson, with Assistants Dickens and Pratt, will occupy Mount Tamalpais and make the regular observations of the triangulation and latitude and azimuth. After that the party will occupy another mountain station and then Professor Davidson will leave for New Mexico to observe the transit of Venus. Assistants Rodgers and Forney are to continue the primary triangulation northward, their first station being King Peak in Humboldt County. Assistant Langteller will sail to-morrow with his party for the Umpqua River, in Oregon, where he will take up the coast triangulation and topography, working southward to connect with the survey of Coos Bay.

Assistant Rockwell is now at work on the survey of the Columbia River, doing both topography and triangulation. Assistant Gilbert is also at work at the triangulation and topography of Hood's Canal, in Washington Territory. Assistant Einbeck will continue the transcontinental triangulation. He will work in Southern Nevada and Utah this season. Assistant I. S. Lawson will go south and proceed to make primary triangulations from Point Concepcion northward. The Coast Survey steamer Hassler, under command of Captain Nichols, has been at work since April on the survey of the Alaska coast. The steamer McArthur is to continue the off-shore topography north of Point Arena, and the schooner Earnest will continue the hydrography of the Straits of Fuca. The permanent magnetic observatory of Los Angeles has been placed under the charge of Marcus Baker. The differential changes of the magnetic forms are recorded continuously by the aid of photography, and for three days of each month the absolute measures of magnetism are observed.—*San Francisco Chronicle.*

IMPROVING THE MISSISSIPPI.

THE QUESTIONS BROUGHT BEFORE THE COMMISSION NOW IN SESSION IN THIS CITY.

The Mississippi River Commission, which has charge of the expenditure of the money appropriated during the late session of Congress for the improvement of that river, has been in session this week. The President of the commission is Gen. Q. A. Gilmore, and the other members are Gen. C. B. Comstock, United States Army; Major Charles R. Suter, United States Army; Prof. Henry Mitchell, of the United States Coast Survey; Major B. M. Harrod, United States Army; Capt. James B. Eads, and Judge R. S. Taylor. All the members of the commission are in attendance except Capt. Eads, who is at present in Europe, and Judge Taylor, who is sick. The Secretary of the commission is Lieut. Smith Leach, United States Army, and the executive officer, who supervises the work, is Capt. C. B. Sears, United States Army. Work on the river is now going on at Plum Point, about 60 miles above Memphis, and at Lake Providence, about the same distance above Vicksburg. The work at Plum Point is in charge of Capt. J. G. D. Knight, and that at Lake Providence under Capt W. L. Marshall. The amount appropriated for the improvement of the river below Cairo is $4,128,000; from Cairo to the mouth of the Illinois River, $600,000, and from the latter point to the Des Moines Rapids, $200,000. There are also a number of unexpended balances, the principal of which are $110,000 for work at New Orleans, $89,000 for work at the mouth of Red River, $27,000 for work at Vicksburg, $7,000 for Natchez, and some smaller sums for other points, making in all over $5,156,000 which the commission will have to expend. The bill names New Orleans, Natchez, Vicksburg, and Memphis as points where improvements shall be made. The present meeting of the commission is called to consider what portion of the appropriation shall be allotted to the points mentioned in the bill, and also whether any portion of the appropriation shall be expended for levee repairs, and if so, what amounts and at what points. The commission will also consider several special questions which have been referred to it by the Secretary of War, but which are not yet in a shape for publication.

The commission effected its organization on Monday, and on Tuesday and yesterday listened to the views presented by the members of three delegations which are in attendance on the session. One of these delegations appears in the interests of the Louisiana levees, another for the Mississippi levees, and the third for the city of Vicksburg. Senator Lamar, of Mississippi, who is one of the delegates, spoke in favor of Mississippi's interests in general and Vicksburg's interests in particular. Judge Steele, formerly of New Orleans, but now of Natchez, Miss., spoke in behalf of the Louisiana levees, and endeavored to impress on the commission that the destructive floods to which the banks of the Mississippi are subjected are caused by the accumulation of waters in what are known as the Yazoo and Tensas bottoms, from the mouth of the Red River to the mouth of the Arkansas, and that it is within these points also that the greatest difficulties of navigation are to be found. He urged, therefore, that the levees along this portion of the river should be closed first. Col. Percy, of Mississippi, and Major Waddell, of Vicksburg, spoke to the same effect. The proposition of the Memphis & New Orleans Railroad and Levee Company to build between those cities a road which shall cross the mouth of the Yazoo Valley upon the top of a levee, the levee to be built out of the Government appropriation, but maintained by the railroad company, having been referred, after introduction into Congress, to the Secretary of War, and by him referred to the commission, C. P. Huntington, the president of the company, was heard in its favor. The hearing of these gentlemen occupied the commission up to noon yesterday, and during the afternoon various questions were discussed by the members. Among these were the establishment of a general supply depot at St. Louis, the amounts of the allotments for the various points where work is required, and various questions of administration. No definite action was taken, however, except that it was decided that a sufficient allotment should be made to the improvements at Plum Point and Lake Providence to enable the work to be carried on without interruption. The improvements at these points consist in the building of screens and sinking of mattresses with the object of narrowing the bed of the river, and thereby increasing the velocity of the current. It is probable, too, that work will be speedily begun at one or two other points.

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MEXICAN NATIONAL.

Advices from the City of Mexico are that the State of Michoacan, by federal authority, has declared forfeited the subsidy granted to General Palmer for his narrow-gauge railroad, projected from Salamanca to Morelia, and that the State of Colima has also declared forfeited a State subsidy to the same road. Considerable grading along the line of the road has been done, but the work of construction will hardly be continued with the subsidy forfeited. The latest information regarding General Palmer's efforts to place the Mexican National loan abroad is that about $500,000 only has been subscribed, which renders the undertaking a practical failure.

The above paragraph from the *Evening Transcript* of July 29 is so crowded with misstatement and ignorant statement that it is, perhaps, worth while explaining the real facts of the case, for the protection of that portion of Boston which may read or trust the *Transcript*.

"The State of Michoacan, by federal authority, has declared forfeited the subsidy granted to Gen. Palmer for his narrow gauge road from Salamanca to Morelia." The State of Michoacan does not act by federal authority any more than does the State of Massachusett or New York. The subsidy granted Gen. Palmer for this line is a subsidy from the national government of Mexico, and the State of Michoacan can no more forfeit it than the State of Delaware can forfeit a national bank charter from the United States. State nullification of national legislation is not a part of the constitution of Mexico.

As to this Michoacan concession, the facts are these: The main line of the Mexican National Railway to the Pacific runs from the City of Mexico, through Toluca, Acambaro, Patzcuaro, etc., to the sea. That portion of the line from Acambaro to Patzcuaro runs through the State of Michoacan. The line for the whole route to the Pacific, however, was granted, subventioned and built under a concession from the federal government of Mexico, dated October 13, 1880.

Some time anterior to this date the federal government had given to the State of Michoacan a concession for a line running through its own borders and touching at Acambaro, Morelia, Patzcuaro, Salamanca and some other points. To provide against any possible claims or allegations of adverse rights, the Mexican National Construction Company took this old concession off the hands of the State of Michoacan by a transfer from that State to the company, dated December 13, 1880.

The actual line of the road-bed, as it now stands on the ground, from Acambaro via Morelia to Patzcuaro, has been, however, constructed carefully under the national concession and strictly according to its terms and conditions. This position has been established by law at each successive stage of construction. The surveys have been reported to the National Government, as demanded by the national concession, and formally accepted by the government. Regular inspections of progress of work have been made by a federal inspector from time to time, and the work accepted and approved by the government. Some months ago, on a technical point, the Governor of the State of Michoacan declared the forfeiture of the contract of transfer of the old concession. By the terms of the transfer itself, all that is forfeited by the State of Michoacan is the transfer. The company has appealed to the Supreme Court against this action of the Executive, and there the case rests. Even in case of an absolute forfeiture of this transfer of concession, it would only effect the company on the short branch line—about 40 miles—from Salvatierra to Salamanca. On this line no work has yet been done, consequently nothing is lost or imperiled except a right of way.

As to the Colima concession the facts are these: This subvention is a State grant of $1,500 per kilomètre, and is additional to the national subvention of $7,000 per kilomètre under the general concession. It covers only that portion of the main line running through the State of Colima—about 80 miles—and is payable in State scrip. Even if forfeited, it would not affect either the right of way or the national subvention on any part of the line. The company, however, has no advices of any such forfeiture. There could be in this sudden way no absolute forfeiture. The first step, under the concession itself, must be a declaration of forfeiture by the Governor of the State, against which the company has the right of appeal, if it chooses to exercise it.

As to General Palmer's negotiation in London, the misstatement here appears to be intentional and malicious, inasmuch as the *Transcript* itself, on the 19th or 20th of July, published a statement, furnished it at its own request by the Secretary of the company, presenting clearly the facts of the case, which are these: By a contract dated June 26, 1882, General Palmer negotiated with a strong European syndicate $10,000,000 of the first mortgage six per cent. bonds of the Mexican National Railway. This syndicate is represented in London by the old house of Matheson & Co., No. 3 Lombard street, whose head is Sir Alexander Matheson, M. P.; in Paris, by the Société Générale. The syndicate under this negotiation took $5,000,000 of these bonds firm, with an option of $5,000,000 more. How or when these bonds are put on the open market does not affect the company, which has already sold them to the syndicate. Whether the statement made by the *Transcript*, that the first public issue of them amounted to $500,000, or whether it was more or less, is not known to the company. It is not a transaction of theirs, and the syndicate has not communicated to them the information, as it is a business affair which pertains purely to the syndicate itself, and not to the company. The statement of the *Transcript* as to the amount taken, labors under the disadvantage of being made in a paragraph of which every other statement is false.
—*Boston Journal.*

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LUNAR INVESTIGATIONS.*

No papers on the moon published during the past year (1880) exceed in importance those by Mr. G. H. Darwen on the secular effects of tidal friction, on the configuration of a planet and its satellite. In the first paper the theory of a deformation of a viscous or imperfectly elastic spheroid under the attraction of satellites is investigated. Numerical calculations show that bodily tides in the earth are at present very small. From this point Mr. Darwen was led to consider the perturbed rotation of such a spheroid and the reaction on the perturbing bodies. He has, in the A. N. 2,294, given the following summary of the results arrived at through these investigations, which no doubt mark the beginning of a new era in our knowledge of the past history of the solar system.

1. The lunar period must have been shorter in the past, and may be traced back from the present 27.3 days, until, initially, the moon revolved round the earth in from two to four hours.

2. The inclination of the orbit to the "proper plane" must have been larger in the past and may be traced back from the present 5° 9′ until it was 6° or 7°. This was a maximum inclination, and in the more remote past the inclination was less, and initially, was very small, or zero.

3. The inclination of the proper plane to the eliptic must have been greater in the past and may be traced back from its present 8° until it was in very early times about 11° 45′. It is possible that initially this inclination was less and that the 11° 45′ was a maximum value.

4. The eccentricity of the orbit must have been smaller in the past. Either at one time it had a minimum value, before which it had a maximum value, and again earlier, it was very small or zero, or else the maximum value never occurred, and the eccentricity has always been increasing. The history of the eccentricity depends on the nature of the tides of the earth, but the former of these alternatives seems the most probable.

At the present time the earth rotates in twenty-four hours, its equator is inclined at an angle of 9° to a plane which Mr. Darwin calls "the proper plane of the earth" (the mean equator). This proper plane is inclined at an angle of 28° 28′ to the eliptic, and its intersection with the eliptic is the equinoctial line. He finds that the frictional tides in the earth have caused changes which may be summarized as follows:

5. The day must have been shorter in the past, and it may be traced back from its present value of twenty-four hours until initially it was from two to four hours in length.

It was then identical with the moon's period of revolution as described in (1).

6. The inclination of the equator to the earth's proper plane must have been larger in the past, and may be traced back from the present value of 9°, until it was about 2° 45′. This was a maximum inclination, and in the more remote past the inclination was less, and initially it was very small, or zero.

7. The inclination of the earth's proper plane to the eliptic must have been smaller in the past, and may be traced back from its present value of 23° 28′ until initially it was 11° 45′, or perhaps somewhat less. It was then identical with the proper plane of the lunar orbit, and this is true whether or not 11° 45′ was a maximum inclination of the lunar proper plane to the eliptic as described in (1).

The preceding statements may be subject to varieties of detail, according to the nature of the tides raised in the earth, but the above is a summary of what appears to be the most probable course of evolution. The hypothesis which is suggested as most probable is, that the more recent changes in the system have been principally due to oceanic tidal friction, and that the more ancient changes were produced by bodily tidal friction. The initial state of the moon, nearly in contact with the earth, and always opposite the same face of it, suggests that the moon was produced by the rupture (in consequence of rapid rotation or other causes) of a primeval planet whose mass was made up of the present moon and earth. It is a remarkable coincidence that the shortest period of revolution of a fluid mass of the same mean density as the earth, which is consistent with an ellipsoidal form of equilibrium, is two hours and twenty-four minutes; and that if the moon were to revolve about the earth with this periodic time, the surfaces of the two bodies would be almost in contact with one another. The theory gives an interesting explanation of the rapid movement of the inner satellite of Mars.

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* From the Smithsonian Report for 1880, page 212

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GAS, WATER AND STEAM PIPES MADE OF STEEL.

The substitution of steel for iron grows more marked every day, says the *London Trade Exchange*. There are now several experiments making in the use of a much lighter steel tube for those of wrought or cast iron, and that with a decided advantage for steel for both pipe and fittings for water, gas or steam. In fact, as steel is the more compact metal, more uniform in character, and can be just as easily worked and a much less weight of metal used, its advantages are at once apparent.

Judging by the results of experiments in England and France, there is every possibility of the complete substitution of steel. Steel is far more durable, and as $\frac{1}{8}$-in. steel pipe equals a $\frac{3}{8}$-in. of wrought, and $\frac{5}{16}$ to $\frac{1}{2}$ in., the great economy which steel effects in labor and transit is at once apparent. The ordinary stock sizes of the tubes vary from 4 in. to 3 ft., in diameter, and they are in 12-ft. lengths. The unions are made by lap-folding and the sections are all tested by a heavier pressure than they will be subjected to in actual use. Mild steel varying from $\frac{3}{16}$ in. to $\frac{5}{16}$ in. in thickness is used in their construction.

A series of elaborate tests made in Paris on a set of steel tubes 3 ft. 8 in. in diameter and 3 millimeters thick proved that these mains had more resisting power than the ordinary mains manufactured either from wrought or cast iron. The vertical variation of the steel tubes 3 ft. 8 in. under a pressure of twenty tons continued for one hundred and thirty hours was only equal to 2.58 in. per cent., an amount that would be practically inappreciable in street traffic and heavy wear. The result of the test was deemed so satisfactory by the Paris authorities that a steel main was laid down from the Gas Works at St. Maude to the Place du Trone. For condensing or refrigerating purposes, again, light, thin steel tubes possess obvious advantages over cast or wrought iron.

Every description of joints, bends, spiggot ovals, flats and circular are made with equal facility, and the tubes can be either with or without flanged joints, or in any special form that may be required. The tubes are made and flanged by special hydraulic machinery, which insures perfect accuracy of the flangs and uniformity in the diameter in the pipes. The weight of a steel tube 24 in. diameter is 5 cwt. We have said enough to prove the great superiority of steel over either cast or wrought iron for mains of every description, while in the matter of cost and other incidental advantages in the way of freights and labor the steel is most advantageous in every way.

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THE ESCUINTLA-GUATEMALA RAILROAD.

[From Special Report of Col. G. M. Totten.]

The proposed Escuintla-Guatemala Railroad will be an extension of the Guatemala Central Railroad. The latter road commences at the port of San Jose, on the Pacific ocean, and extends to Escuintla, a distance of 38½ miles towards the city of Guatemala, the capital of the Republic.

This railroad will extend from the terminus of the Central Railroad at Escuintla, to Guatemala city, giving this capital railroad communication with the port of San Jose, the principal port of the Republic.

The location of this road was made by Mr. A. J. Scherzer, Civil Engineer, under whose direction and supervision the Guatemala Central road (lower line) was located and constructed. Mr. Scherzer has also estimated the quantity and quality of the excavation, embankment, masonry, bridging and other work that will be required in the construction of this road; all which I have examined, with the aid of the maps and profiles, and such inspection of the ground as time permitted, and have every confidence in their accuracy.

The length of the road as located by Mr. Scherzer is 38½ miles.

The gauge adopted is one meter, or 3.29 ft. (with privilege to change to 3 ft.)

The minimum radius of curvature will be 600 ft.

The grades will be steep—the elevation to be overcome being 3,896 ft. in a distance of 35½ miles.

The steepest grade will be 4½ per cent., or 235 ft. per mile.

Escuintla lies at an elevation of 1,123 ft. above the sea. The summit point, 35½ miles distant, has an elevation of 5,019 ft., and the terminus at Guatemala City is at an elevation of 4,878 ft., so that there is a rise from Escuintla to the summit of 3,896 ft., and then a descent to the capital of 141 ft.

Adopting Mr. Scherzer's estimates of the quantities of excavation, embankment, masonry, etc., and such prices as the character of the work requires in that country, we obtain the following result:

197,992 cu. yds. of earth excavation; 318,832 cu. yds. of earth embankment; 16,800 cu. yds. of solid rock; 46,050 cu. yds. of loose rock; 2,707 cu. yds. of arch culverts' masonry; 2,579 cu. yds. of first-class masonry, 6,634 cu. yds. of second-class masonry; 4,306 cu. yds. of dry wall masonry; 1,100 square ft. of paving; 1,666 running ft. of pipe; iron viaducts and bridges and freight; 400 ft. of tunnel; grubbing and cleaning 38½ miles; total cost of grading, masonry and bridging	$731,706 20
Cost of track, including freight and charges, ties, steel rails, 40 to 45 lbs. (ballast, ties, switches, sidings, etc.), ready for use	319,117.93

It only remains to estimate the cost of station buildings, shops, tools and fixtures, which will not be very extensive at the start. However, we will allow for them $150,000. We have then for the estimate:

Cost of the Railroad and Rolling Stock.

Grading, masonry and bridging	$731,706.20
Track	319,117.93
Station buildings and fixtures, freight depots, etc	100,000 00
Shops and tools	50,000.00
Fencing, telegraph and cattle gurads	25,000.00
Rolling stock	137,020 00
Contingencies—10 per cent	136,284.41
Cost of road and equipment (say $1,500,000)	$1,499,128.54

NOTES.

Limiting Depth of Light.

The limiting depth to which light penetrates in water was some time ago stated to be about 131 ft. for Lake Leman by Professor Forel, who used albumenized paper in his experiments. Mr. Asper has recently made similar experiments on the Lake of Zürich by a somewhat different method. He used the photographic plates called emulsion plates—more sensitive than albumenized paper—and immersed them during the night of August 3 to depths of 131, 164, 197, 230, 262 and 295 ft. They were brought up after remaining 24 hours in the water, and were treated with oxalate of iron. All the plates, without exception, were distinctly affected by the light. It will, therefore, be seen that the chemical rays penetrate in clear water to a depth of at least 295 ft.

Railroads Seventy Years Ago.—From the *Montreal Daily Star* we clip the following:

Mr. J. H. Dorwin has kindly furnished us with a copy of the following letter, written, in reply to a suggestion concerning railroads, by Chancellor Livingston, who had been associated with his brother-in-law, Robert Fulton, in the application of steam to navigation:

Albany, March 15, 1811.

Dear Sir: I did not till yesterday receive yours of the 25th of February; where it has loitered on the road I am at a loss to say. I had before read of your very ingenious proposition as to the railway communications. I fear, however, on mature reflection, that they will be liable to serious objection, and ultimately more expensive than a canal. They must be double, so as to prevent the danger of two such heavy bodies meeting. The walls on which they are placed must be at least four feet below the surface, and three feet above, and must be clamped with iron, and even then would hardly sustain so heavy a weight as you propose moving at the rate of four miles an hour on wheels; as to wood, it would not last a week. They must be covered with iron, and that, too, very thick and strong. The means of stopping these heavy carriages, without a great shock, and of preventing them from running on each other—for there would be many running on the road at once—would be very difficult. In cases of accidental stops, or necessary stops to take wood and water, etc., many accidents would happen. The carriage of condensing water would be very troublesome. Upon the whole, I fear the expense would be much greater than that of canals, without being so convenient.

R. R. Livingston.

Sharks and Suez Canal.

An unforeseen consequence of cutting the Suez Canal has been the intrusion of sharks in large numbers into the Mediterranean Sea, with terrible resulting havoc among the smaller edible fish. Formerly a shark was almost a curiosity in the Mediterranean, and there was no choicer or better stocked fishing ground in the world. The fishermen of the Provençal coast supplied the cities of France with the best of piscatorial food, and in never-failing abundance; but they now have difficulty in furnishing half the quantity that they then obtained with ease.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Galveston (Texas) Water Supply.—The Committee on Water Supply has submitted the following report: The Hon. Mayor and Board of Aldermen of the City of Galveston. Gentlemen: Your Committee on Water Supply, to whom was referred the several propositions to supply the city with water, beg leave to state that they, the members of said committee, like all others interested in the future of Galveston, can see, and not without considerable concern, the growing need of an ample, reliable and wholesome fresh water supply for domestic, fire, sanitary and other purposes, deeming the same next only to the problem of deep water, which we may now consider resolved into a question of time, and that but short. But the problem of a permanent fresh water supply, to come within the reach of all, and at the same time be pure and wholesome, is now of the first importance, and the question of supplying the same should be by us put into tangible shape as soon as possible; but in so doing it will be well for us to act on a terse old saying by "making haste slowly."

First and foremost of all is the question of a reliable and healthful source of supply. Second, whether it shall be supplied by a private corporation, or works owned by the city; and the third question is the matter of water rates, or cost to the city and private individuals. These questions can only be answered by a thoroughly practical hydraulic engineer. By making the necessary investigation, and formulating plans and specifications, upon which the city can have built, or a responsible company, taking the contract, can be required to build in accordance therewith; and from the estimated cost on these plans the water rate can be established. As to what these rates shall be, your committee, and no one not having considered the cost, can accurately state, and guessing is not a safe way to get at it. By way of comparison, one proposition before your committee offers to supply water for private use at 15 cents per 100 gallons. The city of Austin is so supplied at 5 cents per 100 gallons. The rate named for similar purposes in Council Bluffs is 35 cents per 1,000 gallons for the least supply, and 15 cents per 1,000 gallons for the greatest, while Peru, Ind., is supplied at the rate of 15 to 20 cents per 1,000 gallons. These figures are not given as a basis whereupon to establish a rate for Galveston, as our position in relation to the location of a supply is by no means similar to those of the cities named. Yet we hold that the rate named for us may be excessive, and would make the water-works and its commodity a luxury indeed.

We would, therefore, in view of the foregoing facts, suggest the propriety of employing a first-class engineer, such as is employed by other cities for like purposes, to make a thorough examination for an available source, and this fact ascertained, then to draw plans and specifications for the construction of a system such as we shall, in his judgment, require; and upon the estimated cost thereof, the rate can be established. Then the city to advertise for bids to construct said works in accordance with these plans. Either for the city's ownership or for a company to own same with the privilege of hydrant and other rates for a certain number of years as their remuneration.

Concerning a proposition to erect for and at the city's expense a system of salt water supply for fire purposes in certain district known as "the fire limits," your committee are in doubt as to the general good to arise therefrom. There is no doubt in the minds of the members of your committee that it would be of great benefit to those doing business and owning property in the district where these works would be operated, but would it be of equal benefit to the taxpayers at large, especially those who have no interest in the limits named, except it be that of cleaning brick and other like works by days' labor! To such it has the appearance of the greatest good to the smallest number. And as we have on inquiry learned that the service could not be made available for fresh water, it would in a few years become a dead loss to us. We therefore respectfully recommend that it be not adopted.

All of which is most respectfully submitted.

P. Barry.
R. Ketchum.
H. W. Jaeger.
Committee on Permanent Water Supply.

The report was adopted, and the committee was instructed to correspond with an engineer looking to an ascertainment of the cost of a survey for fresh water.

The Department of Public Works of Chicago have submitted plans for three-feet water mains, compound duplex pumping engines, necessary foundations, and details to cost $250,000, for a high pressure supply for a portion of the south division of the city. An ordinance authorizing the construction of the works was also prepared, and the whole matter referred to the Finance Committee and Committee of Fire and Water of the City Council.

The Richmond, Va., Gas Works.—The United Gas Company, of Philadelphia, have submitted a proposition to the Richmond board of aldermen to lease the gas works from the city for thirty years, at the rate of $50,000 a year. If the first proposition is accepted it is made a condition that the price of gas to private consumers will be reduced from $2 to $1.75 per 1,000 feet.

Nahant, a rocky peninsula near Boston, where a few rich people go every summer in quest of pure sea air, had a severe outbreak of typhoid fever last year, there being about eighty cases. Nearly all, as investigation shows, were due to bad drinking water. These people, who gave so much attention to upholstering, sunk wells and let the water take care of itself. Out of 190 wells and cisterns examined, 111 were bad.

Work has been begun on the foundations for a new high-service pumping engine for the St. Louis, Mo., water-works. It is expected that the engine will be completed about the end of 1882.

Catskill, N. Y., has voted to have water-works after the plans of John Lockwood, Hydraulic Engineer, 52 Broadway, N. Y. The Company is known as the Catskill Water Supply Co.

The Extension of the District Water-Works.—Major Lydecker, Engineer Commissioner of the District, will take charge of the extension of the water-works. Preparation for the work will begin immediately.

Artesian Wells.—Denver, Col., Aug. 9.—Commissioner Horace Berch, who was appointed by the Agricultural Department at Washington to select the sites for two experimental borings for artesian wells in Colorado, made a trip to the prairie land in the eastern portion of the State to-day. He was accompanied by Senator Hall, the originator of the artesian well bill, and several railroad officials. The party went to the Platte (divide between the headwaters of the Republican River and the South Platte), 112 miles from the city, on the line of the Chicago, Burlington & Quincy Railroad. The geologist commission of last year reported this section of country as bearing the most promising indications of a high water strata. One well will be sunk about a mile from Akron in a country heretofore dry and arid. Contracts will be immediately let for 2,500 ft.

It is thought that a strong flow will be tapped within 1,000 ft. The second well will probably be located near Kit Carson, on the Kansas Pacific road. The contracts on both wells will have been completed by snowfall. It will be remembered that the original $20,000 appropriation for artesian well explorations in Colorado was squandered under *Le Duc's* management. He started a well near Fort Lyon, and paid a heavy royalty to experiment in sinking with a diamond drill. When a depth of only 800 ft. had been reached by the bore the appropriation was exhausted. It was estimated that the same result could have been had under contract for $1,500. Senator Hill obtained the last appropriation from the agricultural fund, and is confident of discovering the flowing well belt. If successful, a vast expanse of country now barren and uninhabited will be converted into lands for agriculture and stock-raising.

Artesian Wells.—The experimental well being sunk at the Peoria water-works is now down to a depth of 750 ft. Sulphur water was struck at 715 ft. and is still flowing. They will continue to go down until they strike a vein of good water.

Victorian Water-Works.—A return has been issued of the various Victorian water-works on Dec. 31, 1880, showing their positions, storage capacity, drainage area, length of aqueducts, mains and reticulations, and total or estimated cost. The works number 43, of a total storage capacity of 12,984,682,868 gallons, the cost being set down as £3,628,291.

ELECTRICITY.

The Electric Light has been adopted by the city council of Belleville, Ill.

RIVERS AND HARBORS.

The Improvements on the Potomac River.—Major Peter C. Hains, of the Corps of Engineers, has been ordered to assume charge of the improvement of the Potomac River in the vicinity of Washington, the establishment of the harbor lines and the raising of the river flats provided for in the act approved August 3, 1882, relieving Mr. S. T. Albert, civil engineer, who has charge of the work at present. Major Hains has the reputation of being an excellent officer. He was for some years stationed at Baltimore, and he has constructed some of the lighthouses in the most difficult localities on the Florida reefs and elsewhere. He is a son-in-law of Rear-Admiral T. A. Jenkins.

STREETS, DRAINAGE, ETC.

The commissioners appointed to prepare a plan for disposal of the sewage of Saratoga Springs are still engaged in the consideration of the subject. The *Saratogian* states that they have substantially agreed upon a plan for collecting the solid deposit to be used for fertilization, letting purified water pass into Saratoga Lake. The details of scheme, however, are not yet fully matured.

The Cincinnati Board of Public Works have awarded the contract for the construction of sewers in District No. 1, Division 8 (being nearly the whole of Ward 17), to Chas. M. Steele, at his bid of $70,339.25.

Drainage of Melbourne.—The City Council of Melbourne is endeavoring to improve the drainage of the Victorian metropolis. At the last meeting of the council, plans of a drain for carrying off the flood waters of North Carlton and the southwest portion of Brunswick, estimated to involve a cost of £10,856, and plans of underground drains for storm water in Elizabeth street, estimated to cost £44,880, were approved. It was further resolved that these plans should be submitted for approval and concurrence to the Minister of Public Works as head of the sewerage department at Melbourne, with a request that he might assist the council by providing a moiety of the funds required for the works, and "credit the council's expenditure in this regard to the city in connection with any general scheme and appropriation for the sewering of the metropolis."

Boston Sued for Damages.—W. C. Pollard and others, the contractors for doing work upon the Moon Island sewer, have brought suit against the city of Boston for an alleged breach of contract, and the damages claimed are $250,000. The plaintiffs claim that the city engineer's plans were drawn so negligently and carelessly that they could not perform the contract according to its terms. These allegations are denied by the defendant, who also files a general denial to plaintiffs' declaration. The suit has been brought in the Supreme Court.

RAILROADS.

New York, Ontario & Western.—The right given to its stockholders to subscribe for $10,000,000 of the New York, West Shore & Buffalo Railroad held by it was generally availed of. The price was 50 per cent. of the par value, and places $5,000,000 in the treasury of the company. Responses were received from all, except a few remote or small shareholders, and almost the entire amount was taken. The terms were 25 per cent. of the amount down, and the remainder in monthly installments of 10 per cent., the last payment to be made not later than May, 1883. The bonds were issued by the West Shore Company to the New York, Ontario & Western in return for the surrender by the latter of its franchise between Weehawken & Middletown. The New York, Ontario & Western is also granted a lease, entitling it to use the line for 99 years. This part of the road, it is expected, will be finished and trains running by Jan. 1.

The Genesee Valley Terminal Railroad Company was incorporated on the 14th. The company is to continue 99 years. The road is to be constructed from or near a point in the center of the line of the Genesee Valley Canal Railroad, in the town of Chili, Monroe County, and thence by the most direct route, taking in the towns of Chili and Gates, to a point in the line of the New York Central & Hudson River Railroad about 800 feet west of the intersection of that road with the Buffalo Railroad in the town of Gates. The capital is $500 000.

Railroad Accidents.—Of those killed by railroad accidents in Great Britain last year, by causes beyond their own control, the proportion was one to 27,050,485. The proportion of the injured was one to 680,854. The totals were 108 passengers killed and 1,854 injured, and of employés 531 killed and 3,445 injured. From trespasses, suicides, and miscellaneous causes death came to 467 persons, and injuries to 265. The risk of travel is seen to be extremely low.

Building Appropriation.—The amount appropriated for public buildings in different parts of the country, is between $5,000,000 and $6,000,000. The various sums are fifty per cent. of what it is estimated will be required in each instance. So the contracts to be let, with the real estate, will amount to between $10,000,000 and $12,000,000.

Tracklaying is advancing well on the New York, Lake Erie & Western Coal & Railroad Company's line from Alton to Johnsonburg, Pa. The big bridge over the Kinzua is considerably more than half done, and they expect to have trains running in about sixty days. Contracts have been let for the construction of the Ridgway & Clearfield Railroad, 20 miles from Ridgway to Brockwayville. Barnes & McFadden are the chief contractors. They also hold the same relation to the New York, Lake Erie & Western Coal & Railway Company, mentioned above. These roads are situated in Elk and McKean counties, Pa., and a couple of weeks ago tracklayers were in demand. Nearly all classes of labor were scarce, as men were in demand in the bark-peelings and hay fields, at $2.00 per day.

Street Railway.—A stock company has been formed to construct another street railway in Jackson, Mich.

Railroad Incorporated in Arkansas.—Articles have been filed by the Des Arc & Brinkley Railroad to run from Des Arc, Prairie County, to Brinkley, where the Paramore narrow-gauge road crosses the Memphis & Little Rock.

Improvement of the Springfield, Effingham & Southeastern.—Sullivan, Ind.—The Springfield, Effingham & Southeastern has just completed arrangements to put its road in first-class condition, and to build a branch from here to Indianapolis for the purpose of developing the extensive coal-fields of this county, W. C. Lyon, General Manager, is now in Indianapolis completing the details, and we learn from P. H. Blue, Superintendent, that Charles Seymour, the Chief Engineer, is now here, and a full corps of engineers will be put in the field next week.

Denver & Rio Grande Extension.—The Utah extension of the Denver & Rio Grande Railway has been completed to Cimarron, 330 miles from Denver and 407 miles from Salt Lake City. As the company has now in operation about 108 miles of road extending eastward from Salt Lake City less than 300 miles remains to be built to complete the connection in this link. The grading is nearly finished, and the preparations made for rapid track-laying indicate that this new through line will be opened by Dec. 31.

New Illinois Road.—Articles of association were filed for the New York & Council Bluffs Railway company, capital stock $425,000; incorporators, Isaac B. Hymer of Fort Wayne, and James B. Martin, Andrew Hancock, Frank H. Stive, William B. Whiffen, Gustavus A. Moats and George Marsh, of Lacon. The principal office is at Lacon.

Road Completed.—On the 11th inst. the last rail was laid that completed the Northern Pacific Railway between St. Paul and the crossing of the Yellowstone River opposite Billings. Inasmuch as the bridge is not finished trains cannot enter the town yet. The road will be pushed to the base of the Rocky Mountains by autumn, and trains will probably run over a temporary switch back into Bozeman this winter.

The Kansas City & Memphis.—The Kansas City & Memphis Railroad Company are pushing work on the line rapidly, and expect to finish to Memphis early in March. Mammoth Springs, Fulton County, is the point of the road's entrance in Arkansas, and Augusta Station, three miles north, will be the end of the first division. Three contractors are now at work on the line, and work is now progressing on every mile of the road. The total force of 1,000 laborers and 500 teams has been ordered doubled. The track will be of steel rails and the bridges of iron.

Ironed.—The Chicago, St. Paul, Minneapolis & Omaha line in Northern Wisconsin is now ironed to a point within 80 miles of Superior. The line will be opened during the next 90 days.

The extensive works in connection with the terminus of the Grand Trunk Railway at Wiarton will be advertised in a few days. The amount to be expended is $50,000.

The New York & Sea Beach Railroad is to be sold by the Sheriff to satisfy two mortgages, amounting to about $434,000.

The Grand Trunk Railway Company has, it is said, entered into an agreement with Mr. Senecal and the North Shore Railway Company to build a branch line giving them uninterrupted connection between Quebec and Ottawa independent of the Canada Pacific Railway Company. They have also rescued the South Shore Railway and Tunnel charter and the Montreal & Sorel Railway, and will embark all their live freight for the British market at Sorel instead of at Port Levis.

The Canada Pacific Railway.—Work on the Canada Pacific Railway construction has now reached 357 miles west of Winnipeg, and rails are being laid at the rate of three miles a day. The Thunder Bay section will not, it is officially announced, be opened for traffic this year.

The N. P. R. R.—Tracklaying has been resumed on the Casselton branch of the Northern Pacific Railroad in Dakota from Mayville to Larrimore. On the Little Falls and Dakota the track is laid to Sauk Centre, and it is expected the line will be completed to Morris—87 miles—by Oct. 1. Track on main line was laid into Billings, Mont., on the 11th inst.

Declining an Award for Damages.—Montreal, Aug. 15.—The arbitrators in the railway case between the local government and Duncan McDonald, the contractor, have awarded the latter $138,000 damages for the taking of the Occidental Railway contract from him. McDonald declines the award as being inadequate.

CONTRACTS LET.

A Street Contract Let.—A dispatch from La Salle, Ills., of late date, says: The Committee on the bottom road improvements met and awarded the contracts to the lowest bidders, as follows: B. F. Holland, of Utica, 38,093 cubic yards of grading, $7,999.53; Geo. Brown, of Peru, graveling 2,444¼ cubic yards, $1.955; rock work, L. Sanderson, $3,577.70, which, together with the $1,000 to be expended on the southern approach to the bridge, will make a total of $14,532.83. This roadway is over a mile in length, and crosses the Illinois River valley south of this city.

Contracts Let for Telegraph Line.—Contracts have been let at Buffalo for the construction of a portion of the postal telegraph line between that city and Chicago, and work on the Indianapolis branch will commence August 21.

Contract Let for Iron Work.—Samuel J. Creswell, of Philadelphia, has been awarded the contract for the cast iron work of the Lehigh Valley Railroad offices, at Mauch Chunk, and the large iron portions for the Swarthmore College, Delaware County, Pa.; also the stable fittings for the West Philadelphia and Lombard and South Street P. R. W. Co., Philadelphia.

A Kansas Railroad Contract Let.—C. G. Patterson, a Boston capitalist, has contracted to build the Topeka, Salina & Western Railroad westward from Topeka a distance of 180 miles. The line is practically an extension of the Leavenworth, Topeka & Southwestern Railroad.

Stone Contract Let.—The contract for the stone work on the public buildings at Toledo, Ohio, has been awarded to the Collins Granite Company, of Bluehill.

Dredging Contracts Awarded.—The New York State Engineer has awarded the following contracts: For dredging 10,000 cubic yards of earth and sand at Catskill Creek, to E. M. Payn, at 13.9 cents per cubic yards; for dredging the same amount at New Baltimore, to P. W. Myers, at 14 cents per cubic yard; for dredging 15,000 cubic yards at Troy, to E. M. Payn, at 30 cents per cubic yard.

Hungarian Contracts.—Contracts have been concluded by the Hungarian State railways for the purchase of 126,000 tons of rails, all of which will be supplied by native works.

It is announced that a competition of schemes for the construction of bridges over the Danube, to connect the Kustendje-Tchernavoda line with that of Bucharest-Fetettei will shortly be opened at Bucharest. Alternative projects for connecting these lines by means of a tunnel under the river will also be considered. Prizes amounting to 100,000 francs will be given for the best bridge plans, and 50,000 francs for those of the tunnel. The bridge works are estimated at about twenty millions of francs.

The contracts for the grading of the Silver City, Deming & Pacific Railroad between Deming and Silver City were let last week. It is expected that the road will be in operation by the first of next spring.

The following contracts were awarded at Kansas City on the 9th by the city engineer: Bluff st. bridge to the Wrought Iron Bridge Co., of Canton, O., at $9,865; work to begin at once and to be completed within ninety days. Constructing eighteen-inch sewers in sewer district No. 46, awarded to Wm. Faulkner at $1.89 per lineal foot, or $2,832.98 for the entire work. Curbing and guttering west side of May st., from Fifth to Sixth, awarded to P. Moore, at $1.10 per lineal foot.

The contract for the granite work on the proposed monument at Monticello, Va., in honor of Thomas Jefferson, has been awarded to Dominic McMenamin, of Washington, for $3,500. The contract for the iron work of the fence, etc., has been awarded to the Manly & Cooper Manufacturing Company, of Philadelphia, for $3,440.

David V. Howell of New York City was awarded the contract for the construction of a life-saving station at Gale Beach, N. J., his bid $11,887, being the lowest.

There was a large attendance of contractors at the District Commissioners' office on Saturday, 12th, to witness the opening of bids for the extensive street work recently authorized by appropriations by Congress. The streets and avenues to be improved have been heretofore published in *The Republican*. The bids were opened by Lieutenant Greene, Auditor Vincent, and Chief Clerk J. C. Rock, and were as follows: Paving with asphalt block portions of Fifteenth west, Fourth east, Twenty-ninth west; bidders, William Hussey, $2.29 per yard; Patrick Maloney, $2.19; James Reynolds, $2.35, $2.35, $2.30; John Cudmore & Co., $2.43, $2.41, $2.39. Improving North Capitol street from E to K streets, Thomas Joyce, 19 cents for grading, etc.; James Reynolds, 17 cents; Bartholomew Readon, 15 cents; W. H. Maler, 21 cents; for improving F street, from One-half and Four-and-a-half southwest, P. Maloney, 18 cents; W. H. Mahler, 21 cents; Thomas Joyce, 18 cents; James Reynolds, 17 cents.

LAYING ASPHALT PAVEMENTS

on portions of New Jersey avenue, Massachusetts avenue, Rhode Island avenue, New Hampshire avenue, and Pennsylvania avenue, Fifth street east, M north, Twenty-sixth west, and Thirty-third west, all of which will be repaved with asphalt except between the car-tracks, where granite blocks will be used—H. L. Cranford, $2.26 for asphalt, 94 cents for granite blocks; A. L. Barber, asphalt, $2.25; granite blocks, 90 cents. Repairs to bituminous pavements—H. L. Cranford and A. L. Barber were the bidders, the former being the lowest. The committee reported as

THE RESULT OF THE SCHEDULING

the following: For paving with asphalt blocks, Peter Maloney's aggregate was $30,966.60, the others being respectively $32,380.60, by William Hussey; $33,081, J. E. Reynolds; $34,159.42, John Cudmore. For paving with asphalt, A. L. Barber was the lowest bidder for the work on New Jersey avenue, New Hampshire avenue, Pennsylvania avenue, Fourteenth street west, Second street east, D street southeast, Fifth street southeast, M street northwest, and Thirty-third street northwest, H. L. Cranford was the lowest for Massachusetts avenue and Rhode Island avenue. The committee will report on the other work to-day.—*National Republican*, 14th.

BRIDGES.

An Important Bridge at Lowell Burnt.—At three o'clock on the 5th, the Central Bridge in Lowell, across the Merrimac River, was destroyed by fire. It connected Centralville with the main part of the city, and as the nearest bridge now left is about 2 miles distant, great inconvenience will be experienced. The fire caught from a portable engine used by the Boott Cotton Mills in laying the foundation for a mill which they are extending into the stream. The first bridge at this point was built by a chartered toll company in 1825. The city secured and made it free in 1855, paying $26,000 as damages and costs. The structure was rebuilt in 1864 at a cost of $34,000. It was a wooden covered bridge, standing on two piers, besides end abutments. It had become inadequate for the public need, and a resolution passed the City Council last year to rebuild with iron at an early date. This disaster will expedite the work. Another iron bridge is in progress about half a mile up the stream, but cannot be utilized for several months. A cheap temporary pontoon bridge has been hastily constructed from the débris, which is used by pedestrians.

At a special meeting of the City Council on the 5th, a resolution was passed to proceed at once with the building of a new iron bridge, to replace the Central Bridge, not to cost over $100,000. Its length is 585 feet. The city is now running a steam tug for free transportation of the public.

A Long Bridge.—The Pensacola & Atlantic Railroad bridge, over Escambia Bay, Fla., two miles and a quarter long, is finished.

May Bridge the Rock River.—An election will be held in Byron, Ill., on the 29th inst., to decide the question of the town borrowing $15,000, with which to construct a bridge across Rock River at that place.

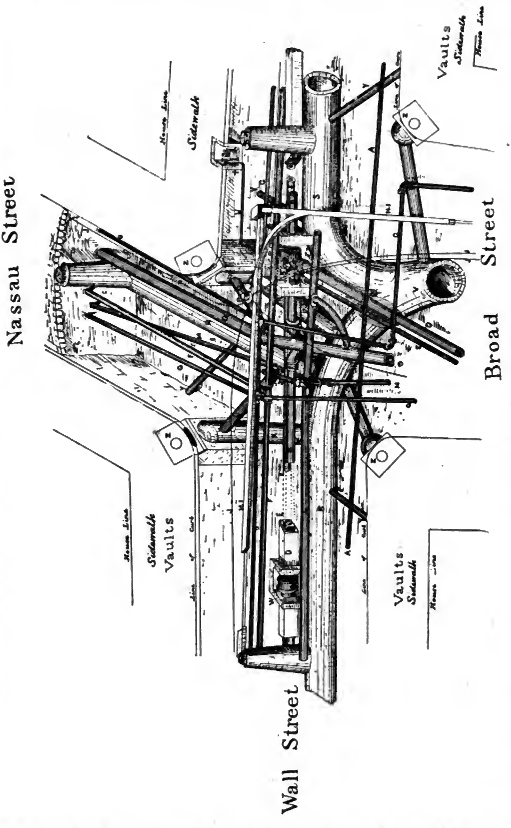
A Pennsylvania Bridge Company Incorporated.—A charter was issued to the Bradford Bridge Company, of Pittsburgh, which proposes the erection of a bridge across the Youghiogheny at Bradford. Capital stock, $100,000.

MISCELLANEOUS.

The Geo. D. Webb Granite Co. has purchased the entire granite works of Mr. R. L. Angier, of Fitzwilliam Depot, N. H., and has greatly enlarged its facilities for quarrying by introducing steam drills, steam derricks, etc., and is building new sheds to employ more stonecutters.

The Court-house of Randolph County, Missouri, at Huntsville, has been burned to the ground. The building cost $88,000, and was insured for $10,000.

The new pumping engines of the London, Ont., water works were started on the 15th. They were manufactured by Killey, of Hamilton. The contract calls for 2,000,000 gallons per day.



Sketch Showing the Ground Under Carriageway at Intersection of Wall, Broad, and Nassau Streets, as Occupied by Water, Gas, Steam, Pneumatic, Cable and Electric Pipes, Sewers, Basins, Culverts, Drains and Vaults to Houses, August, 1882.

REFERENCES.

A—6-inch N. Y. Gas.
B—Wall street sewer.
C—12-inch water pipe.
D—10-inch N. Y. Steam Co. pipe (steam).
E—4-inch N. Y. Steam Co. pipe (return).
F—6-inch Mutual Gas.
G—4-inch N. Y. Gas.
H 1—Western Union pneumatic and cable tubes.
J—Edison electric tube.

K—Old basin outlet (removed).
L—New basin outlet, 15-inch pipe.
M—6-inch water pipe.
M 1—Line of 6-inch water pipe (before alteration).
M 2—Line of 6-inch water pipe as altered.
N—Nassau street sewer.
O—20-inch water pipe.
P—Edison's electric junction box.
Q—New basin outlet, 15-inch pipe.

R—Old basin outlet (removed).
S—Wall street sewer.
T—N. Y. Steam Co. steam trap.
U—2-inch trap pipes.
V—Broad street sewer.
W—Expansion, joint and service box N. Y. Steam Co.
X—Junction vault of N. Y. Steam Co.'s mains.
Y—House drains.
Z—Catch basins.

ASKING FOR AN AQUEDUCT.

Public Works Commissioner Hubert O. Thompson sent to Mayor Grace, Thursday, the quarterly report of the work done by his department during the three months ending June 30 last. The total expenditures for the quarter amounted to $1,133,156.19, making a total of $2,071,397.66 since January 1. During the quarter 113 contracts of various kinds were made, the total estimated cost of which was $1,605,282.23. The number and cost of contracts entered into from January 1 to June 30 were nearly double those for the same period in any of the preceding six years. Regarding the water supply Commissioner Thompson reports that although the rain-fall for the first six months of 1882 in the Croton and Bronx River valleys was from 1.35 to 3 inches less than in 1881, yet for various reasons the supply of water at the Croton Dam was greater than last year. The report continues:

"The average surplus of water running over the Croton Dam into the Hudson River during the past six months, above the quantity required to fill the reservoirs and lakes and to keep the acqueduct running at its full capacity, was 500,000,000 gallons per day. Our aqueduct was therefore able to deliver only one-sixth of the supply which might, with sufficient storage and conduit capacity, have been brought to the city. If we had Niagara Falls instead of the Croton River to draw upon we could not, until we have another aqueduct, receive in the city and deliver one drop of water more than we are now distributing. The aqueduct has delivered without interruption a little over 95,000,000 gallons of water per day, which is all that can safely be passed through it. The same quantity has been delivered for the past 10 years, and when the population was several hundred thousand less than now, and complaints of inadequate pressure prevailed even then in some parts of the city. Yet, judging from complaints constantly received by the department, there appears to be many people who do not understand that, without means to increase the quantity of water available for use in the city, the growth in consumption of water entailed by the growth of the city in population, buildings, commerce and manufactures, must produce a corresponding decrease in the force or head with which the water can be delivered in the houses. The warning that this constant decrease of force is inevitable until a new supply can be brought in has been repeated by the department again and again; but, whatever attention it may have received from the general public, it seems that little heed is paid to it by the authorities to whom we have to look for power and means to increase the supply. It is believed that a very large majority of the people of the city are convinced from their own observation and reasoning, aside from any statements or arguments of the department, of the immediate and imperative necessity of an additional aqueduct; but the bill for its construction, which had the approval of the Mayor, the Controller, the Counsel to the Corporation, and the Commissioner of Public Works, and passed the Senate and Assembly in 1881, failed to receive the approval of the Governor, and at the last session of the Legislature, although amended to meet the Governor's main objection, remained in the hands of committees, and did not come to a vote in either the Senate or Assembly.

"The predominance of commerce in the life and business of New York is so great that people lose sight of the fact, as shown by the census of 1870 and 1880, that in the value of its manufactures it far exceeds any other city and county in the United States. Abundant water supply is so essential a requisite for manufactures that a deficiency of supply will surely reduce the city to the second and possibly to the third or fourth rate as a manufacturing center. People from other cities, States and countries cannot understand why the Metropolis, with its vast properties and interests, should hesitate to avail itself of the comparatively simple and inexpensive means of securing an abundant supply of the purest water by constructing another aqueduct from the Croton River. Boston, Philadelphia, Baltimore, Chicago, St. Louis and other cities greatly inferior to New York in population, wealth and importance, which have also had the experience of outgrowing their water supply, have promptly met the emergency by the construction of new works under far greater difficulties and proportionately greater expense."

At the close of the quarter, there were in the city 523 miles of distributing water pipes, with 5,480 stop cocks, 6,818 fire hydrants, and 6,875 meters. Figures are given of the amount of work done in repairing and strengthening the aqueducts and on the Bronx River reservoir and conduit line.

On April 1 there were 40 men and 4 carts engaged in repairing pavements, against 441 men and 81 carts on June 30. Repairs were made during the quarter in 206 places.

"The operations of the steam companies give occasion to refer again to the great difficulty of keeping our streets in proper condition with so many and various structures under their surface, and such frequent removals of pavements and excavations of the soil. The permits issued to these companies during the present season enumerate thirty-three different locations, each including from one to five blocks of streets to be excavated for laying pipes, all in the section of the city below Chambers street, in which there is probably more business and traffic concentrated than in any other equal space in the world. It is not surprising that this work, carried on under such circumstances, should have caused, and does cause, great inconvenience and annoyance to the people, and gives rise to many complaints; but some of the complaints are very unreasonable in attaching undeserved blame to this department. The department exercises all its legitimate power with vigilance and energy to have the work so conducted as to reduce the inevitable evils accompanying it to the smallest possible limit. Skilled and careful mechanics are placed by the department as inspectors over each work, their services being paid for by the companies. Full and minute instructions accompany the permits to meet every contingency that may arise in the progress of the work, and to secure complete restoration of the streets, protection to public structures with which it comes in contact, and as little interference as possible with public travel. Some complainants treat the matter as though this department were the cause and originator of the whole work, whereas it is carried on by private corporations under franchises granted by the Common Council, and the department has only a certain limited supervisory power in regard to it."

Accompanying this portion of the report is a large and interesting diagram (see preceding page) showing the underground pipes at the junction of Nassau, Broad and Wall streets, giving an idea of the difficulties to be contended with in laying two complete systems of steam-pipes in the streets under the direction of rival companies. The diagram shows 24 separate structures intricately interlaced at the spot named and are described as follows:

"Sewers, gas-pipes, water-pipes, steam-pipes, electric and pneumatic tubes, sewer basins and culverts, and the appurtenances of these different works. It presents only the average conditions encountered in most of the streets in the lower part of the city. There are numbers of places where the underground structures are more numerous and complicated. The matter which is the most frequent cause of complaint and misunderstanding on the part of the citizens is the restoration of pavements over excavations. The first replacement of the pavement over the trench is not intended to be, and cannot be made, of a permanent character, because more or less settlement of the soil and pavement must always occur. After such settlement the companies are required to relay the pavement, and to relay it again as often as necessary for one year until it is firmly and evenly restored. They will be held to the strictest fulfillment of this obligation."

"The annexed diagram showing the underground structures at the junction of Nassau, Broad and Wall streets, gives an idea of the difficulties to be contended with in laying two complete systems of steam-pipes in the streets under the direction of rival companies.

The report states that on June 30 the total length of sewers south of the Harlem River was 386.83 miles, with 4,617 receiving basins. The total number of public gas lamps in the city was 28,666, and there was 72 electric lights. During the month of June 405,287 persons visited the public baths, of whom 139,188 were females. The Water Register collected during the last quarter $471,534.92, of which $466,889.82 was for Croton water rents. The other revenues of the department amounted to $61,586.39.

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WHAT CONSTITUTES A PUBLIC NUISANCE.

A fence was built across a street in 1852 by a railroad company, and in 1881 an owner of one of the houses on the street filed a bill in equity to enjoin the company from maintaining the fence, on the ground that it was a public nuisance. The bill was dismissed for two reasons, set forth by the Pennsylvania Court of Appeals as follows: 1. A court of equity will not protect a person against a public nuisance unless he shows that he suffers some special injury; if his injury is that only which is suffered by the public generally, he cannot procure an injunction. 2. In this case the complainant has been contented with the condition of the street for nearly thirty years, and he has slept so long upon his alleged injury that he cannot find relief in equity. To fail to assert a right promptly is to forfeit the privilege of enforcing it in equity, and here the delay has been so long continued that that alone is sufficient to deny the relief asked.

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ENGINEERING PROGRESS IN CHINA.

Another few years will probably see the vast empire wholly opened up to foreign enterprise, to become a receptacle for the surplus energy and wealth of the West. It is partially so already, but each year from now, will dawn upon an ever advancing and more enlightened empire. With this prospect in view, it is desirable that England should be thoroughly *au fait* with every phase of the industrial revolution; engineers especially, those to whom of necessity will fall the task of disinterring China's magnificent subterraneous riches, should be most thoroughly posted in every particular relating to Chinese industry and policy, otherwise others may step in and reap the rich rewards that should, it is not too much to say, be ours by right of inheritance. To many, whose time has been chiefly devoted to watching the currents of events so rapidly passing in Europe and America, the progress made by China during the past ten years will appear little short of astonishing. To some, indeed, accustomed to look upon its inhabitants as a race of strange barbarians, the industrial conquests won since the Chefoo treaty was signed, will read very much like a dream—too good to be true. Nevertheless, the progress recorded in Blue-books, Customs' reports, and Shanghai journals, is real and tangible. Briefly, how does the matter stand at present? The mining problem has been effectually solved in the successful working, with foreign machinery, of the Kelung and Kaiping collieries; also by the application of foreign machinery to a few of the many coal, iron and copper mines known to exist in various directions thoughout the empire. Telegraphy has grown quite common—a sort of every-day affair since the construction by the Great Northern Telegraph Company, of the double wire overland line joining Shanghai with Tienstin. The route taken by this telegraph line follows as nearly as possible that chosen by the engineer of the Grand Canal, along the edges of which the posts are mostly erected. Its total length is said to exceed six hundred miles. Several shorter lines have also been constructed connecting different commercial centres; while at Shanghai and elsewhere the multiplicity of telegraph posts is fast becoming a nuisance, if not a positive source of danger to foot passengers and vehicles; any way, the matter is evoking repeated complaints in the English printed papers, more than one among which sides with the complainants against the telegraph companies. The Shanghai and Tienstin main line is remarkable for the fact that it was practically ordered and paid for by the Imperial Chinese government, the object in view being more strategic than commercial. But for the Russo-Chinese embroglio this great and far-reaching achievement, might have remained unperfected for years. That danger, and the disadvantage the government found themselves placed in, through the absence of speedy intelligence from the provincial capital cities, led to the immediate construction of telegrapic communication between the northern and southern provinces. A shorter line connects Tientsin and Taku, and another is contemplated between the former city and Pekin. Even in the island of Formosa the chief towns are in communication, and so rapidly are the posts being put up everywhere, that Mr. Dering's anticipation in the Imperial Maritime customs reported for the year 1880, that "after one wire has crossed the high walls of the capital, the telegraph will prove in China as irresistible as it did in every other country, and that its meshwork will, before the close of the century, expand all over the empire," is likely to be realized even sooner than he expected. "*Ce n' est que le premier pas qui coûte*," he adds. Since June 18, 1881, when these words were penned, the first great step and several smaller ones have been taken; astonishing progress has been made.

Nor is the sister science—telephony—a complete stranger in a strange land. At Shanghai, many public buildings and merchant's offices are connected; an exchange, has been started; while at the annual general meeting of the Shanghai General Chamber of Commerce, held April 6th last, the President, Mr. F. B. Forbes, was able to announce the pleasant news that Mr. Tong King-Sing had obtained official sanction from the viceroys of Chihili and Nanking, to have the telephonic communication between the town and the Siccawei Meterological Observatory presided over by the Rev. Marc Dechevrens, for the purpose of weather reports. Elsewhere, the telephone is not unknown: indeed, it is being set up in nearly all the towns where foreigners reside; still, for all the great signals noting the progressive spirit now among this Oriental race, one must follow out the annals of Shanghai, where perhaps one-half the total Europeans are centred.

Having mentioned the name of Mr. Tong King-Sing, the foremost of native pioneers in the cause of progress and science, it will not be irrelevant to pay a passing tribute to the great work accomplished by this enlightened Chinese gentleman. To him, and to his influence over the mind and purse of Si Hung-Chang, one of China's most progressive spirits, the empire entirely owes its present enviable maritime position. The China Merchants' Steam Navigation Company—a native enterprise already possessing thirty steamers, with an aggregate tonnage between twenty and twenty-five thousand tons, and which last year sent the dragon flag flying merrily up the Thames—was wholly conceived and carried out by this enterprising engineer. He still retains the position of managing director, although his time must be seriously occupied with his other numerous adventures. This country is also indebted to him for the innovation of the telegraph and telephone, for the favorable solution of the mining difficulty, for the successful working of the Kaiping coal and iron measures, and for the opening up of a dozen other valuable deposits. To him, also, we may rightly ascribe the revolutionizing of the Chinese navy through the supercession of the antiquated war junk, by the European ironclad steamer; nor would it be any exaggeration to say that without Mr. Tong King-Sing and his powerful coadjutors, the viceroys of Chihili, Nanking and Kansuh, foreign machinery and steam might yet have been unknown to their countrymen. History will also couple the names of the late She Pao Chen, Si Hung-Chang and Tong King-Sing with the introduction of railways and tramways into the empire. That unfortunate little enterprise, the Woosung Railway, was conceived by these and kindred spirits, and the two latter are still unrelaxing in their efforts of development. Nor will their appeals be long made in vain. Necessity, the mother of invention, and, as economists say the prime cause of civil progress will compel the throne to authorize railroads at no distant day. Progressive China already clamors for them, while strategical difficulties encountered during the Russian, Japanese and Corean entanglements have taught the China of tradition a serious lesson. The Commissioner at Tientsin writing on this subject on the 10th of June, 1881, remarks: Although not as yet like the telegraph, an established fact in China, the railway is, it may be augured, not far from becoming one. It is no secret that in the course of the past year a strong movement, prompted by the political and military difficulties of the moment, was set on foot in favor of its introduction; that all possible advantages and disadvantages of the institution were freely and exhaustively discussed by the leading statesmen of the empire; and that even many memorials bearing on this interesting subject were deposited on the steps of the throne.

That a decree ordering or authorizing the construction of railways would change the whole political, military and commercial status of the Empire no one conversant with the history of the past sixty years could doubt. China is still considered by many as being 200 years behind the countries of the West. The discussion that marked proceedings last year sufficiently proves that China is getting aware that now-a-days she, too, must follow in the wake of nations in order to hold her own in the hour of competitive test. Discussion, it is true, has for the present ceased, but there are signs that soon it will be revived, and once revived it will lead to action.

This is nothing but the truth; truer to-day than when written. This discussion is being revived, and next year, even this, may see some action taken. Despite the fate that attended the toy Woosung Railway, which, banished from Shanghai, now lies uncared for in a ricketty godown on the shores of Formosa, a victim to each insetting tide, the era of railways in China is near at hand. Then, and not till then, will commence in earnest the task of disemboweling her magnificent wealth.

Gas works are likewise becoming acclimatized in China, and Tientsin and Foochow are just now in a fever of expectation at the prospect of gas works at an early date. Still it is just possible that the marked advance made by electricity during the past few years may arrest this progress. Capitalists are, as a rule, too shrewd to advance money for any enterprise which a few years may see largely superseded by a superior system of lighting. Moreover, the present high price of coal in the commercial centres of China, places the gas companies at a terrible disadvantage when competing with their formidable rivals. At existing rates the Shanghai companies have to charge four times as much as in England, and even then their profits are not enormous. This disadvantage will doubtless be removed during the next few years, when the native coal mines come to be worked in earnest.

In this place it may be well to allude to the kindly disposition displayed by the Chinese in regard to lighting arrangements. Although naturally too poor as a rule to avail themselves of gas (at $3.50 per 1,000 ft.) they have from the very first appreciated the great advantages possessed by Western methods. Both the Shanghai Gas Company and *La Compagnie du Gaz*, a French undertaking, were popular with the provincial authorities, meeting with official support from their earliest conception. Commercially, as well, both have proved fortunate, the Tes 100 shares being in each case quoted at over 50 per cent. premium. More notable still, the Kaiping coal mines, sixty miles N. N. E. of Tientsin are illuminated with gas supplied from gasometers actually constructed at the company's workshops. As if this achievement was insufficient, the Chinese Engineering & Mining Company, to whom those rich coal and iron deposits belong, have built their own locomotives in view of the expectant withdrawal of existing orders against its use. Although little attention has been attracted by this fact here, it is not without its meaning. No one should forget that the enterprise named is steadfastly supported with the influence—and with the money also, it is believed—of His Excellency Si Hung-Chang, one of China's most powerful ministers. It is scarcely probable he would authorize the building of locomotives at what may be termed his own works, were the present policy likely to obtain for long.

Before passing from the railway question, it may be mentioned that a line is contemplated between Peking and Tientsin, from which base it is eventually to be continued to Newchwang and Moukden, if not to Kirin, which town would then become the furthest base for offensive and defensive operations in case of war with the Czar. No engineering difficulties worth mentioning present themselves to retard the successful construction of the proposed railway. Not until the line passes Moukden is the country at all hilly, nor are there any streams of importance in the way. From a strategic point of view this road would be of incalculable advantage to the Government in massing troops on the Russian frontier; indeed, rapid communication between the Peking, Tientsin, and the Yingtszu district will become a prime necessity when once the fortifications at Lu Shun-how and Ta-hin-wan are completed, otherwise these advanced posts, together with others situated in the Corea, would stand every show of being cut off from their bases by a hostile expedition. So keenly is this fact felt in the capital, that the first rails would, without doubt, have been laid long ago, had the national exchequer permitted the requisite outlay. That the authorities should hesitate before mortgaging their soil to strangers is only natural. Still, on the other hand, it is safe to conclude that the impossibility of doing without railways will speedily prove the stronger influence. Let Peking be forced, as it will be soon, to ask foreign capital to build this railway, and that agency will be allowed its free scope to build when, where, and how it chooses.

Mr. Morrison, the engineer of the Woosung Railway, will then find little obstacle in the way of effectuating his long conceived project of a main trunk line from Canton in the south to Woochang in the interior. This town, situated, by the way, almost exactly opposite Hankow, is the capital of the province of Hupeh. Between it and Canton, the proposed line would pass through many important cities, besides opening up several rich coal and iron districts. The engineering difficulties to be conquered are comparatively small, consisting of two imposing ranges of hills—mountains would be almost a better term—several smaller ranges, and numerous inconsequential streams. By the route proposed not one formidable river will have to be bridged, nor for the matter of that, can the tunneling or climbing difficulties be in any way considered stupendous. Without doubt this project might be carried out at relatively inconsiderable cost, could permission to construct the line be once obtained. Modern science would make short work of the few engineering obstacles presenting themselves when once the capital required was forthcoming, and upon this score there is little reason for alarm. With such a prodigious population to support it, the line could not fail to prove a financial success, and like the little Woosung Railway, it would yield a magnificent return upon the money invested. If we remember rightly, that pioneer enterprise returned over 10 per cent. on the purchase price from passenger traffic only, and Mr. Morrison's great project might almost be expected to do as well. Omitting for the moment the question of receipts from merchandise, which could not be otherwise than large, seeing the provinces to be intersected are among the most populous and fertile in China, those derived from passenger traffic would unquestionably be large—sufficient almost to pay expenses. The number of prefectional (Fu) and independent (Chow) cities connected by the line in its course to Woochang would alone astonish continental engineers, accustomed to cut through one big centre in every 100 miles or more; but to these cities must be added a far greater number of district (Hsien, and subordinate Chow) cities also opened up. The aggregate population of these towns must number many millions; nor is this surprising when we reflect that acre for acre the provinces of Kiangsu, Angwei and Hupeh are two or three times as thickly populated as the United Kingdom. Nor does this sufficiently indicate the advantages possessed by Mr. Morrison's route. Throughout the valley of the Yangtze, which the railway will traverse, human life is more prolific than in any other part of China, while, as a body, the people are decidedly better off. With such favorable conditions, it would be bound to prove commercially successful; but, further, the cost of construction should be small, labor in China very cheap, while coal and iron deposits exist in several places alongside the suggested route. Next, the country is quite flat as a rule, while, as already said, the graver obstacles are few. The local railways also proposed between Shanghai and Hang-chow, Shanghai and Soochow, with future connection between Hang-chow and Soochow; between Tientsin and Taku, and between Canton and Fatshan, would presumably answer; so likewise might that contemplated by the Central Government for Tientsin to Newchang and beyond, as the districts passed through are generally flat, rendering construction simple and inexpensive. None of these lines offer any great opportunity for the display of engineering enterprise or intelligence. The same cannot be said, however, about the stupendous conception which is first of all to join Peking and Tientsin with the Yangtsze valley, and which, crossing that mighty stream, will subsequently run southward towards Canton. In the first portion of its course the Hoang-ho will have to be bridged in its wider parts, unless crossed by other means. This river of itself offers an obstacle that may well-nigh prove insurmountable even to nineteenth century science. Flooding the country for miles on each side during the summer months, frequently to a depth of 20 ft. or more, with a current tearing down with such velocity that powerful steamers can scarcely force their way upward against its impetuous, headstrong torrent, the Yellow River may well be regarded with anxiety by the boldest of modern engineers. But crossed it will have to be by some means or other; so also will its almost equally formidable sister, the Yangtsze-kiang, which rises between 40 ft. and 50 ft. at times.

Three ways of overcoming these obstacles are open: 1. To bridge the rivers—an undertaking involving great labor, serious future danger, and which, if successful at all, could only be accomplished by an extraordinary outlay of money, rendering dividend paying a question for the remote future. 2. To tunnel beneath them. This, likewise, is a somewhat uncertain and hazardous project, one that would certainly entail a tremendous outlay, and like the former plan, would make dividends an after consideration. 3. To convey the loaded trains bodily across upon powerful, lengthy, flat-bottomed steamers. This will probably be found the wisest and best course to commence with, as being the most economical, and most likely to bring about an early return for capital—a matter of vital importance to a commercial enterprise, especially in a country constituted so strangely, socially and politically, as China is. Even this last alternative has its disadvantages, so far as the Yangtsze-kiang is concerned, unless the line crossed the lower river below Nyan-king. In places during the winter months the Yangtsze is almost devoid of water the current itself being at times unnavigable. As a consequence, the running of the steamers could not be permanently guaranteed, if the railway crossed between that town and Hankow, unless the greatest care was taken in selecting a suitable spot, and the shallows were bridged. But another difficulty would then present itself in the shape of numerous shifting shoals. What in one year is deep water, may be dry land in another. The Hoang-ho, on the contrary, has generally ample water, winter or summer, and offers no obstacle to the working of a steam ferry, provided the boats are of sufficient engine power to disregard its powerful current. If this plan were adopted, it would be possible for the North and South Trunk line to generally follow the course of the Grand Canal to Chin-kiang, and thence *via* Soochow and Hang-chow, through the rich provinces of Cheh-kiang, Fukien, and Kwangtung to Canton, connecting Foochow, Amoy, Swatow by main or branch lines. This trunk road would pass through the following provinces: Chihili, Shantung, Kiangsu, Cheh-kiang, Fukien, and Kwangtung, possessing an approximate area of 320,000 square miles, with a population of some 148,000,000, or, say, an average of over 460 per square mile. Chihili, Kiangsu, and Cheh-kiang, through which the more important sections of the line will pass, give respective averages of about 475, 850, and 670 per square mile, or considerably higher than Belgium or England. Moreover, population is densely distributed along the route which this trunk would traverse, while occasional slight deviations, assisted by inexpensive short branch lines, would connect many other important cities. Chihili, it may be interesting to state, contains 17 towns of the first and 144 towns of the second magnitude; Cheh-kiang, 11 and 78; Fukien proper, 9 and about 50; and Kuantung, 15 and 89.

A second trunk railway should flow north from Macao and Canton along the borders of Kiangsi, cutting the Yangtsze at Woochang, and the Hoang-ho at or near Kai-fong, subsequently joining the other road near the borders of Shantung. With the aid of connecting links and short branches, the rich and densely peopled provinces of Hunan, Kiangsi, Hupeh, Honan, and Anhwei would be placed in quick communication with the sea coast at Tientsin, Shanghai and Canton. This latter port, as well as Swatow and Amoy, seems destined to attain a grandeur hitherto unthought of, when once a railway system is created. Nearer to the west, by several days, than Shanghai, they must become outlets for the rich trade of the southern interior, unless, as looks ultimately inevitable, the Shanghai Woochang line should be continued in a southwesterly direction through Yunan and Mandaley to the Bay of Bengal. It can hardly be doubted that these initiatory railroads will pay and pay well the cost of building, and as permission to lay them may be granted at any moment, it will be well for engineers to be on the *qui vive*.—*Engineering.*

MEETING OF THE SUEZ CANAL COMPANY.

PARIS, Aug. 20.—A meeting of the Suez Company was held here to-day, at which resolutions were passed declaring that it is the duty of the company to uphold the claims already made in favor of the neutrality of the canal, and to oppose all warlike measures taken by England, acting in her assumed character as supporter of the Khedive. The resolutions state that the company's concession cannot be disturbed, even by the Sultan, and that the company reserves to itself the right to claim before a competent tribunal compensation from England eventually.

THE FOUR GREAT PORTS.—Liverpool ranks as the most important port in the world, with an annual tonnage of 2,647,372; London stands second, with a tonnage of 2,380,688; Glasgow third, with 1,432,364; New York fourth, with a tonnage of 1,153,676. As a manufacturing city New York leads the world.

ENGINEERING NEWS
AND
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Tribune Building, New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, AUGUST 26, 1882.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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FIRE SERVICE OF LONDON.—From a conversation between a local reporter and Mr. E. M. Shaw, the chief officer of the Metropolitan Fire Brigade of London, who is now on a visit to this country, we obtain many items in regard to the system of that city, and the appliances in use. London has four fire districts, each of which has a central station communicating with headquarters. In this city all alarms radiate to and from headquarters. The fire alarm telegraph has but recently been introduced in London, though here it has been in use for nearly twelve years. There are 60 signal stations in London against some 600 here. The signal box has a glass front and if a citizen wishes to send an alarm but is unprovided with a key he is authorized to break the glass. There the department's duties are confined to putting out fires and, in some cases, to the investigation of the cause. Here, the department supervises the handling and sale of combustibles and the erection and repair of buildings. Captain Shaw stated that he had only 586 firemen to guard a district of 121 square miles; in this city 600 men look after an area of 41.5 square miles.

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THE GREAT BRIDGE.

A meeting of the trustees of the New York and Brooklyn Bridge was held last Tuesday, and business of much importance transacted. The report of the treasurer for the month ending July 31 showed that the receipts were $135,844, and the expenditures $89,311. Of this sum, $26,198 were paid to the Edge Moor Iron Company; $22,057 to the Keystone Bridge Company, and $5,312 for labor.

The following proposals were received for constructing iron viaducts and station buildings at each end of the bridge:

For Brooklyn terminus:	
Jones & Benner	$185,876.00
Robert L. Darragh	192,044.00
Howell & Saxton	194,733.56
Poulsen & Eger	201,285.10
J. B. & J. M. Cornell	206,357.00
For New York terminus:	
Pittsburgh Bridge Company	117,117.50
Jones & Benner	117,842.50
Robert L. Darragh	121,003.90
J. B. & J. M. Cornell	123,879.70
Howell & Saxton	161,562.00
Hereleman & Co	150,050.00

A resolution offered by Mayor Grace, of this city, was adopted, awarding the contract to the lowest bidders, Messrs. Jones & Benner, for Brooklyn, and the Pittsburgh Bridge Company for the New York work, subject to conditions explained in the next paragraph.

Mr. Murphy, President of the board, in answer to a question as to what provision had been made to insure the prompt execution of the work, replied that twenty-five per cent. of the contract price would be retained until after completion. The following motion, presented by Mayor Grace, was adopted after a breezy discussion: "That a penalty of $500 per day be exacted upon the contract of the viaducts for each day in excess of the time allowed in the specifications."

The following proposals were received for rope-driving machinery:

	Engines.	Machinery.	Total Amount.
Dixon Manufacturing Co.	$7,500	$10,000	$17,500
William Wright & Co.	11,500	8,113	19,613
Phœnix Iron Co.	10,000	12,730	22,730
Southwork Foundry and Machine Co	15,000	10,350	25,350
Norman Hubberd	12,000	13,500	25,500
William Taylor & Sons	11,500	15,600	27,100
Southwork Foundry and Machine Co	17,000	10,350	27,350
Southwork Foundry and Machine Co.	21,000	10,350	31,350
Hartford Engine Co	......	....	37,000
Philadelphia Hydraulic Works	....	....	38,000
Robert Wetherill & Co.	10,000	....	....

The contract called for the completion of the work by January 31, 1882, and a penalty of $50 per day for each day of delay after that date was affixed. The contract was given to the Dixon Manufacturing Company, provided they accept the stipulations.

Proposals for traction rope were receive as follows:

The New York Wire rope and Wire Company crucible cast steel, per pound, 9½c.; John A. Roebling Sons' Company Bessemer steel, per pound, 13c., or this firm would furnish cast steel at 16c. per pound. The Hazzard Manufacturing Company offered Bessemer steel at 14c., and cast steel at 17c.

It was moved and carried that the contract be awarded to the New York Wire Rope and Wire Company—the lowest bidders—if they would guarantee the cable for twelve months under a penalty of ten per cent. of the contract.

The following companies presented bids for furnishing granite for the stone work about the station at the New York end:

Bodwell Granite Company	$4,685.00
Mt. Waldo Granite Company	4,740.00
Cape Ann Granite Company	4,744.80

The contract was given to the Bodwell Company.

In regard to the engineering corps of the bridge, Mayor Low stated that, with the consent of the Mayor of New York and the Comptrollers of both New York and Brooklyn, he visited Mr. Roebling, the chief engineer, at Newport, and suggested to him the placing of his name upon the list as consulting engineer and the appointment of first assistant engineer C. C. Martin as chief engineer. Mr. Roebling did not accede to this proposition, and the Mayor then presented the following resolution to the Board:

"*Whereas*, The Chief Engineer of the bridge, Mr. W. A. Roebling, has been for many years, and still is an invalid; and

"*Wheras*, In the judgment of the board the absence of the Chief Engineer from the post of active supervision is necessarily in many ways a source of delay, therefore,

"*Resolved*, That this board does hereby appoint Mr. Roebling Consulting Engineer, and Mr. C. C. Martin, the present First-Assistant Engineer, to be the Chief Engineer of the New York and Brooklyn Bridge; and

"*Resolved*, In so doing the board desires to bear most cordial testimony to the services hitherto rendered by Mr. Roebling, and to express its regret at the necessity of making the change at this time."

It was decided to lay the matter upon the table until the next regular meeting, Sept. 11.

◆

A BLOW-OUT AT THE TUNNEL.

Last Sunday afternoon a blow-out occurred in the heading at the New York works, flooding the space between the bulkhead and the heading. The gang working at the time passed through the lock and out at the shaft.

The entire work upon this side of the river has been through sand interspersed with small rock and gravel, and at every step great care has been exercised in order to exclude the sand and water and retain the air. Advance is made by sections. An opening is made at the top and a flanged plate inserted; a further opening admits the second plate and so on. These plates are carried the full length of the section when a bulkhead is commenced at the top. The side plates and end plates are carried downward at the same time and held in position by braces. (This system of bracing will be fully illustrated and explained in our next issue.) This forms, practically, a caisson which is enlarged, plate by plate, until there is a cylinder of iron, one end closed by a bulkhead of iron. When this work has been completed and the section cleaned, the masonry is commenced at the invert and carried up the sides and over the arches.

This masonry had reached nearly half way up the sides when the blow-out of last Sunday happened. The precise cause of this occurrence is not known, though it is probable that it was owing to one, or perhaps more, imperfectly secured plates allowing the air to escape. The chamber of the caission and the completed portion of the tunnel up to the air-lock constituted an ample working chamber for the men, and offered a sure retreat in case of an accident of this description.

After the blow-out the pumps were started, but failed to lower the water, proving that there was a connection with the river. On Tuesday a bulkhead of planks was built across the upper half of the air-lock door, when the air pressure expelled the water to the base of this. By this means workmen could enter the lock, the water reaching only about up to their waist, and with jacks force open the outer door of the lock. This was done, and a diver entered, cleared away the displaced braces and floating timbers, and examined the section as well as possible. The masonry already in place was found uninjured, but the roof-plates had been forced into the tunnel. All places where the air escapes will be filled with small bags containing sawdust, and as the section is made tight, the work of repair will continue, the roof-plates being first placed in position, and the work carried forward in much the same manner as it would be in a new section.

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THE POLLUTION OF THE NEPPERHAN RIVER AT YONKERS.

The State Board of Health on Wednesday began an investigation in Yonkers into the complaints made by citizens in regard to the intolerable condition of the Nepperhan River. Commissioner Erastus Brooks occupied the chair, and Dr. Harris, Secretary of the Board, and Mr. Croes, the engineer employed by the Board, were in attendance. Mr. Brooks, after stating the objects of the meeting, called upon the manufacturers and others using the stream to refute the complaints, and asked for suggestions as to the best method of removing the nuisance. Warren Smith said that his firm used the river water for washing wool and dye stuff employed in carpet-weaving, after which it passed into the river, and to some extent polluted it. The water-closets also emptied into the river. They employ about 3,000 hands. Mr. Sluter, who lived near the last dam, complained that in hot weather the stench arising from the river was intolerable. His family could have no ventilation because they were obliged to keep the window shut. Mr. Wieman agreed in saying that during nine months in the year the neighborhood of the river was almost uninhabitable. Messrs. Davis, Rau, Watson and others doing business on the stream complained of the bad odors, but acknowledged that they in common with all the residents along the stream had their privies directly over the water.

Robert P. Getty spoke of the great value of the river as a water power, and said that to take down the dams and let the water flow without being utilized would occasion great loss to the city. He advocated the construction of a sewer which should carry off all the refuse now emptied into the river, and favored contracting the width of the creek to 28 ft., with side walls 10 ft. high.

Dr. Harris said that according to local authorities the refuse of 610 houses, besides many stables and one slaughter house, emptied into the river.

Mr. Baldwin said that his firm employ about 300 operatives. Water closets were not on the stream. All excrement is collected in tubs and taken away to his farm. He uses the river water for washing wool. It is afterwards thrown back into the river.

Mr. Ethan Flogg agreed with Mr. Getty as to the construction of a sewer, but said that any body who advocated it in the First and Second Wards would never be elected to office.

City Engineer Wilson explained the plans prepared by him for the Water and Sewer Commissioners, which provided for intercepting sewers and the removal of all waste and filth from the stream. The common council has refused to order these sewers to be built, but with out them no purification of the stream could be effected.

Ex-Mayor Otis advocated the diversion of sewage from the stream, and stated that Mr. W. E. Worthen had made a conclusive report two years ago regarding the conversion of the stream itself into a sewer, showing that the cost of so doing would be enormous and the result unsatisfactory.

The Board will make their report to the Governor in a few days.

CONTRACT FOR IRON BRIDGE LET.

William B. Knight, City Engineer of Kansas City, Mo., received proposals on July 18 (advertised in ENGINEERING NEWS of July 8), for constructing and erecting the superstructure of a wrought iron highway bridge for the city of Kansas. Bridge to be 133.2 ft. long between center of end pins, and set on a skew angle of 55° 19', with line perpendicular to face of abutments. To have two roadways of 18 ft. clear width each, with 16 ft. headroom, and two sidewalks of 5 ft. clear width each. Trusses to have parallel chords and inclined end-posts, and be proportioned to carry live load of 80 lbs. per square foot on both roadways and sidewalks.

The following bids were received:

1.	Smith Bridge Co., Toledo, Ohio	$7,300
2.	Mount Vernon Bridge Co	8,950
3.	Wrought Iron Bridge Co., Canton, Ohio	9,385
4.	Missouri Valley Bridge and Iron Co., Leavenworth, Kansas	11,000 11,250
5.	H. W. Sebastian & Co., St. Louis, Mo	12,200
6.	Kansas City Bridge and Iron Co., Kansas City	12,028
7.	Pittsburg Bridge Co	12,900
8.	Raymond & Campbell, Council Bluffs, Ia	13,750

Contract awarded to the Wrought Iron Bridge Co.

LITERATURE.

The Fire Protection of Mills, and Construction of Mill Floors. C. J. H. Woodbury. 191 pp. John Wiley & Sons, New York. 1882.

The writer's introduction opens with the apt remark that "The reduction of taxation furthers prosperity by adding to the accumulations of industry and increasing the capital in a community." The cost of fire insurance and fire departments during each of the past five years amounted to $125,000,000, and if the losses can be diminished the cost of insurance will be decreased in a like ratio.

The arrangements for the defense of property against fire are divided into four classes:

The anticipation of all preventable causes of fire.

The preparation of methods of fighting fires by organizations of men.

Water supply for fire purposes, and the best apparatus for the protection of mills.

The elements of construction and arrangement of buildings that offer the best means of retarding the spread of fire.

To obtain the most efficient results from a fire organization in a mill the men should be drilled in the use of the apparatus by actual trial and work. Plans are given which have been tried and proved successful. The water supply is well considered, beginning with the primitive pails, and the author justly states that the "most essential fire apparatus consists of pails of water." This is shown by the fact that twice as many fires in mills are put out by pails than by any other means. Various styles of steam pumps, valves and hydrants are described and illustrated.

Mills have been protected for many years by systems of parallel lines of perforated pipes, connected with a water supply either from pumps or reservoirs; so that the room may be showered by opening a valve on the outside of the building. Several systems are mentioned, and the following subject of automatic sprinklers is fully treated and the various methods of construction shown.

The causes of mill fires are studied and as a natural sequence the best general precautions are discussed in regard to arrangement and the confining of a fire within certain limits. As a prolific cause of conflagration, the lighting apparatus, from the dangerous gasoline apparatus to the recent electric light finds a place in this volume. We find the following good rule under the article on electric light:

"Any conducting wire which is warm to the touch in comparison with another wire is liable to become a source of danger, and should be replaced by a larger wire."

Chapters or divisions of the book are devoted to fires from steam heating pipes, spontaneous combustion and other causes, and their prevention discussed.

The last half treats of mill construction, and opens with a list of certain prevalent features of bad construction which should be omitted. The best plans for the protection of iron columns, by surrounding them by wood or a non-combustible material, are shown. Loads on floors, vibration or oscillation of mills, receive ample and able attention. One of the most important questions in mill construction is the strength of the floors, and to build properly a knowledge is necessary of the character of the material used under various conditions, and of the required dimensions and best forms of building in order to insure an ample amount of strength. This is fully given in every detail, and formulas deduced.

The author states that in columns wood has been found superior to iron, because defects can be easily detected, less cost, and better resistance to fire. Formulas are given for safe loads upon columns of different shapes, and a very complete table of tests of wood mill columns on the U. S. testing machine at Watertown, Mass.

Throughout the entire book the sub-divisions are handled in a manner which shows actual experience and much study; it cannot fail to fill the niche it was designed for.

PERSONAL.

LIEUT.-COL. GEORGE H. ELLIOT, Corps of Engineers, United States Army, who was promoted from major by the death of General WARREN, received his appointment on Friday, the 18th, after being a major for fifteen years and five months.

EYRE M. SHAW, chief officer of the Metropolitan Fire Brigade of London, arrived in this city on the 22d inst. He comes over principally to attend the Firemen's Convention in Cincinnati in September, but will inspect the working of the departments of the larger cities in the United States and Canada.

GEORGE M. BRYANT, well known throughout Ohio as a prominent railroad contractor, and familiarly known as Yankee Bryant, died at his home in Mt. Vernon, O., on the 13th, aged fifty-seven years. He was born at Windsor, Vt., and came to Ohio in 1853, locating in Cincinnati, where for several years he engaged in the construction of railroads.

GARDNER A. SAGE, of this city, died at Greenbrier, W. Va., on Tuesday last. He was a civil engineer, but had long been retired from business. He was 65 years old. His estate is valued at $2,500,000, mainly invested in real estate in various portions of the city. To extensive excavations for buildings in the neighborhood of his residence on Thirty-seventh street he attributed the origin of a malarial disease that had afflicted him for several years. Early this season he went to Atlantic City for his health, and later to West Virginia. He was accompanied by Mrs. WARREN B. SAGE, wife of his brother, who is a wealthy resident of Spuyten Duyvil.

As a civil engineer, Mr. SAGE had much to do with the laying out of the Central Park, and Park Commissioner GREEN relied much upon his judgment. Mr. SAGE took great interest in the Dutch Reformed Church, and was its constant benefactor. His principal gift to the church was the library building and library of the theological seminary at New Brunswick, N. J., which cost about $100,000. His private benefactions were many. Long before the war he was Colonel of the Seventh Regiment of this city. He has one son, living abroad.

MR. CHAS. G. BATCHELLER, Line Engineer of the section from the Maule River to Yumbel on the Chilian State Railway, died suddenly of paralysis in Talca, Chili, June 6, last. Mr. Batcheller had served under the orders of the Late Benj. H. Latrobe, on the Cumberland Extension of the Pittsburgh & Connellsville Railroad, and was a civil engineer of excellent standing and many kindly memories, both in the United States and in South America.

ALFRED GUTHRIE, a resident of Chicago since 1845, died on the 17 inst., at the age of seventy-seven years. He was the son of Samuel Guthrie, the discoverer of chloroform and percussion powder. The deceased planned some of the important public works of that city, was for many years engineer of the Illinois & Michigan Canal, drafted the United States steamboat inspection law, and was instrumental in securing its passage in 1851, and was Supervising Inspector of the lake district for eight years. At the time of his death he was engaged in perfecting an improved water meter.

PROGRESS IN MEXICO.

The two most enterprising men in Chihuahua to-day, who are doing more for the development of Northern Mexico than any others, are American governors—Governor Anthony, of Kansas, and Governor Shepherd, of Washington. Anthony is General Manager of the Mexican Central (Northern Division) and is driving his line forward to Chihuahua and the City of Mexico at the rate of a mile a day. Shepherd is manager of nine mining companies in Chihuahua, of which six are backed by New York and Boston capitalists, one by Philadelphia and two by Washington capitalists. He is developing twenty-two mines; has fourteen large tunnels under way, and has driven upwards of 5,000 ft. of tunneling in the past eighteen months.

An American capitalist has purchased a large piece of land known as "El Jardur del Caballito," in the City of Mexico, for which he paid $50,000. He intends building a first-class American hotel.

RAILROAD NOTES.

For several weeks past 400 men have been at work night and day in the historical "Tajo de Nochistongo," on the line of the Central Railway, near the City of Mexico.

A telegram from Chihuahua says the Mexican Central has reached a point 47 miles from Chihuahua, to which the government telegraph line is also finished.

The commission of government engineers appointed to examine the "Tajo de Nochistongo" have reported that the line is in a good permanent condition there, and recommend the usual repairs to be made with regularity, so as to limit the chance of accidents at this dangerous spot, to the minimum.

Work on the northern division of the National Railway has passed a point called Palo Blanco, and will soon reach Salinas Victoria, which is less than 30 miles from Monterey.

The Vera Cruz Railway Company intends to lower passenger rates.

Seven more kilometers of road have been finished on the Sinaloa & Durango Railway, making a total of 37 kilometers built so far.

All the necessary rails and equipments for the Central Railway Company's line to Chihuahua have arrived on the ground.

According to the official report for the month of July, 15,185 men were employed on the different divisions of the Central Railway.

The National Railway is to run excursion trains from the City of Mexico to Toluca, when the exhibition at the latter city is opened.

A horse railroad is to be constructed immediately from Cordoba to Amatlan, a distance of 7 miles.

The English Railway Company are immediately to commence running a daily fast through passenger train to be called the "Flying Dutchman," between the City of Mexico and the port of Vera Cruz.

Work on the railway from Cuantla to Acapulco was commenced a few days ago.

The Central Railway Company's line from the City of Mexico to Leon is now finished and accepted by the Government. This is the result of the most energetic work in railway construction yet accomplished in Mexico.

An American colony of 700 laborers, with their families, have arrived at Tampico. The men are engaged to work on the Central Company's line between that port and San Luis Potosi, and announce their intention of remaining permanently in the Republic.

VERA CRUZ IMPROVEMENTS.

Upwards of a year ago Captain Eads, of St. Louis, was commissioned by the Mexican Government to furnish plans and estimates of cost for the construction of a breakwater and other improvements at the port of Vera Cruz, which have been accepted, notwithstanding that the most eminent engineers of Mexico were appointed by the Government to give plans and report on the matter. The plans include the construction of warehouses for the reception of imports, a new custom-house, wharves and docks, and the blowing up of the rocks called "Las Cavenderas," in the roadstead. A company is immediately to be formed by Capt. Eads for the execution of the works, the cost of which will be defrayed entirely by the Mexican Government and the municipality of Vera Cruz. The commencement of these works will be hailed as of the greatest importance by the whole of Mexico, and will enable the fine old city of Vera Cruz to maintain her commercial supremacy over Tampico to the north and Anton Lizardo to the south.

ENGLAND EAGER FOR TRADE.

Negotiations for the renewal of diplomatic relations with England are well advanced, and at an early day a plenipotentiary from the Court of St. James may be expected in the capital. And it is noticeable in this connection that English merchants are, through German houses already established, making strenuous efforts to control the trade of the country, which has been really abandoned by them since the troublous times of Maximilian. The foreign trade of Mexico is at present chiefly in the hands of German, French and Spanish houses, which are established at Vera Cruz, the chief port of the country, and the City of Mexica, having branches throughout the country. There are no English houses doing business at Vera Cruz, and only seven are in existence throughout the Republic.

GENERAL ITEMS.

An experiment was recently made with the telephone, from the City of Mexico to Vera Cruz, a distance of 283 miles, which gave the best result, the voice of every person speaking having been distinctly heard at either end.

The Transatlantic and Continental lines of steamers, under a liberal subvention just granted by the Government, will begin their trips to the Mexican Gulf ports in January next. Among others, mention is made of two splendid ocean steamships, the Ciudad de Oaxaca and the Autunana.

Peace, the construction of railroads and the new spirit of enterprise which has of late been awakened throughout Mexico, have tended greatly to increase the price of labor, especially in the cities. Stone masons, for instance, are in great demand in the city of Mexico, and now earn $3 per day. Other labor is paid at unusually high rates.

One hundred and seventy miles of the telegraph line from Paso del Norte to Chihuahua have been finished, and the telegraph line from Zacatecas to Leon has just been completed.

The telephone is coming into general use throughout all the cities of Mexico. Guadalajara, Vera Cruz and Cordoba are having lines erected.

The plant for lightning New Laredo with electricity has arrived; and other improvements which are being introduced, such as building a new theatre and a market-place, indicate the progressive tendencies of this city, which contains 5,188 inhabitants, an increase of 1,549 in one year.

The Central and South American cable has been laid at Salina Cruz, which is the terminus of the Pacific line. Thus Mexico is now in communication with all parts of Central and South America.

The wharf recently finished at La Paz, Lower California, is 697 ft. long by 30 ft. wide.

Several artesian wells are being bored in the city of Jalapa.

The manufacture of socks, stockings and underwear, also other goods of a like description, will be commenced soon in a factory now under construction. The necessary machinery, of the most improved kind, has already arrived from the United States.

It is announced that the citadel of Mexico is to undergo suitable repairs and alterations for its immediate conversion into a general hospital for the city. The building in question is well situated for the purpose, being at some distance from the business center.

An important discovery of petroleum has been made in the middle of Lake Chapala by two English engineers, by boring under the bottom of the lake. This remarkable find has attracted general attention, and it is expected the well will yield 800 barrels a day.

The total municipal revenues of the City of Mexico for the first half of the current year amounted to $633,099.

The manufacture of arms in the City of Mexico is daily improving, and cannon which have been recently turned out for the Government are much superior to ordnance of foreign make.

Owing to the large number of men employed in railroad building in Culiacan, great scarcity of labor exists in other parts of the State of Sinaloa. Especially is this the case in regard to masons and domestic servants.

A fine cathedral is immediately to be erected in the capital of Tabasco.

Mazatlan merchants are in good spirits over the increase of business generally. Recently four large steamers entered the port in a single day.

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THE COMSTOCK LEVEL AND ROD.

This instrument (Fig. 1) consists of three principal parts: The sighting tube, *AA'*, the horizontal circle *C* and *C'* and the base *B*. The sighting tube, *AA'*, is 14 in. in length, and is furnished at the end, *A*, with a pin hole looking through the tube, and at the other end with a small ring placed inside the brass shield holding the cross wires, which are adjusted to the center by means of the small screws, whose heads appear in the cut. This tube rests on the Ys, *Y* and *Y'*, and they in turn stand on the inner circle, *C'*. On this tube at the Ys are two flanged rings, like car wheels, and it is held in its place by the latches on top of the Ys, which are fastened in position by the thumb screw on the top. By loosening these latches the tube may be revolved to test the adjustment of the cross wires.

To adjust the line of sight to the line of level of the circles there are three screws placed at the foot of *Y*, and marked *r* in the cut, which may be turned by a key furnished with the instrument, thus raising or lowering the end of the tube. The horizontal circles *C* and *C'*, are concentric, one revolving inside the other, the outer one being graduated to degrees and the inner being marked at every 45 degrees, so that the instrument may be used in taking angles. The inner circle *C'*, carries the glass bubble, shown in the cut level with the surface of the plate. The bubble itself may be adjusted by a screw beneath the brass plate protecting the glass. Passing through the center of this circle is a screw which binds the several parts of the instrument together, forms the axis about which the circle revolve, and goes into the shank of the ball which appears in the socket of the base. The outer circle forms a support and guide for the inner, and to its spokes are attached the two thumb screws and springs opposite to them by means of which the instrument is leveled.

The base *B*, is simply a solid disk with a smoothly turned outer rim on which little cups holding the feet of the screws and springs may slip easily whenever it may be necessary to revolve the outer circle on the base. The center of this disk is formed into a socket for the ball referred to above. The under surface of this disk has a solid cylinder which sets in the collar of the tripod and is held firmly in its place by means of a stud and set-screw. The center screw and shank of the ball are hollow, so that the cord suspending the plumb-bob may be passed up through the instrument, and is held in its place by the knot in the cord as shown in the cut. From this description it will be seen that this instrument can be adjusted in every way possible in the highest priced instruments, and has besides the additional feature of a horizontal circle, making it in reality a plain transit, as well as a level.

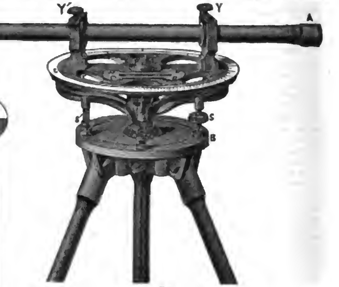

FIG. 1.

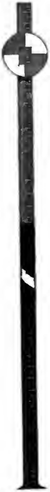

FIG. 2.

THE LEVELING ROD.

This rod (Fig. 2) is round and made in two sections for convenience in carrying, united by a solid screw joint, so that when together it is as firm as if of one piece. A target slides upon the rod.

There are two scales; one side being engineers' (feet, 10ths and 100ths); the other architects' scale (in feet, inches and 8ths).

These instruments are manufactured by Wm. T. Comstock, of No. 6 Astor place, this city.

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CO-OPERATIVE CONTRACTING BY WORKINGMEN.

M. Floquet, the Prefect of the Seine, has drawn up a scheme by which associations of workmen will be admitted to compete for public works in Paris. The workmen's delegates have maintained that if the administration would consent to make regular fortnightly or monthly payments on account, they would undertake to leave as a guarantee until completion a deposit of from 20 to 30 per cent. on each of these payments. The administration has agreed to this arrangement, but exacts other guarantees and conditions on the part of the men: First, The creation of a special fund in aid of those of the associated workmen who may fall ill or be wounded in the execution of the work and for the widows and children of the deceased partners. Second, The establishment of an arbitration board of three members charged to regulate all disputes between the men, without prejudice to the authority conferred by the regulations upon the official architects and engineers. Third, The nomination of one or more syndics, furnished with full legal powers to act on behalf of the association and with certificates of capacity and good conduct; these syndics will draw up the tenders, and, in case of their being accepted, will superintend their execution as clerks of the works, under the supervision of the architects and engineers. In case of the scheme being adopted, a committe of eight members of the Municipal Council will be appointed by that body to decide on the occasion of each public adjudication, as to whether or not the workmen's associations shall be admitted to compete. It is probable that M. Flcquet's scheme, of which the above is an abstract, will be almost unanimously approved by the Council.—*London Architect.*

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THE DELTA OF THE NILE.

The following article from the London *Times* of the 3d inst. will have more than a passing interest to most engineers. It is written by Mr. B. Baker, who was also the author of a series of papers on the Barrage of the Nile:

As a battlefield the Delta of the Nile offers peculiarities which will not be found, perhaps, in any other region of the globe. Many low-lying countries are liable to be flooded by the sea if dykes and banks be broken by accident or design; but in the case of Egypt this liability obtains only for a certain period of each year, the time and duration of which can be predicted with absolute certainty. The rise and fall of the Nile is as sure as that of the ocean tides, though the tidal period is not twelve hours, but a year. It is only for a certain number of weeks before and after High Nile that Arabi will possess the power of flooding Lower Egpt by cutting the banks of the river itself or of some of the main canals. During the greater part of the year the water level is below the level of the lands, as the fellaheen know to their cost, the necessary irrigation having to be performed by sakiehs, shadoofs and other contrivances for raising water the required height. Unfortunately, the period during which the country can be flooded will include the next few months.

During the past thirty years the earliest time at which the Nile attained its maximum height was on the 27th of August, 1868, and the latest on the 20th of October, 1872. A range of nearly two months is thus exhibited; but it must be remembered that the level of high Nile is very nearly constant for some weeks, so for all practical purposes the variation in time would be included within much smaller limits. Taking the average of fifteen consecutive years, the official returns of the Egyptian Government show that the Nile had risen 14 ft. above low-water level the first week in August, and 19 ft. in the third week, 20 ft. in the first week of September, and 22 ft. in the first week of October, and that it had fallen to 19 ft. again in the first week of November, and to 12 ft. in the first week of December. A very high Nile such as that of 1874 may rise no less than 28 ft. above low water level, and the heights at the commencements of the several months enumerated above would be, of course, correspondingly increased.

Generally, the level of the lands immediately adjoining the river may be taken at about 17 ft. above low-water level, while, as the ground slopes away at an inclination of some 5 in. a mile from the river towards the desert, the complete flooding of the country may be said to be secured if the protecting banks be once broken or suffered to be washed away by the rapid erosive current of the High Nile. A cross section of the country, such as the one taken by the Egyptian Staff in 1874, from east to west on a line 12 miles north of the Great Pyramid, shows this very clearly. The High Nile of 1874 stood at this point 66 ft. above the level of the Mediterranean; the level of the ground at the river is, however, only 58 ft. above the same datum; hence, had the banks given way, a stream of water 8 ft. deep would have flowed laterally from the river over the lands. Nor is this all, for, as already remarked, the ground slopes down from the river inland. In the present case, the land near the desert on the left bank of the Nile is but 51 ft. above the Mediterranean, and on the right bank only 41 ft.

Not merely the river, but the innumerable canals, constituting a network of waterways over the whole country, offer facilities for a mischievous flooding of the country. The section above referred to cuts in its course no less than fifteen canals, including the Bassousieh, the Charkieh, and the Ismailieh, or "Sweet Water" Canal, the best known of all, on account of its vital importance to the Suez Canal. To retain the water in these canals high banks have been constructed, as in the instance of the Nile itself. The ground where the line of section crosses the Ismailieh Canal, for example, is but 52 ft. above the level of the Mediterranean, while, obviously, by closing the lower outlet sluices, or by making an earthwork dam across the canal, the water might be made to rise to the height of the water in the adjacent Nile, which, as already stated, stood in 1874 no less than 66 ft. above the Mediterranean. A head of 14 ft. of water would thus be available to flood the lands in this district.

Some two miles north of the line of cross section above referred to is the apex of the Delta, where the Grand Barrage of the Nile and the head works of the three most important canals irrigating the Delta are situate. The canal on the west side, traversing the province of Behera, is of high interest at the present moment, as it is a feeder of the Mahmoudieh Canal, which supplies Alexandria with its water.

The Behera Canal has a mean width at its head works of 180 ft. and a depth of from 20 ft. to 26 ft. at High Nile. If the flood stream of the Nile were allowed to enter the canal uncontrolled, the torrent would rush down and devastate the lands below. Even with a depth of but 10 ft. of water in the canal, the discharge has been found by measurement to be no less than 112 tons per second, or one-third of that of the whole summer flow of the Nile itself. With double that depth the velocity and momentum of the rushing waters would be enormous, and the consequences could hardly fail to be felt at Alexandria itself, though 130 miles distant. The Behera Canal is a comparatively modern work, proposed by Mehemet Ali, and constructed under the superintendence of French engineers. At a point near the village of Beni Salameh, on the left branch of the Rosetta branch of the Nile, and about 25 miles distant from its intake near the apex of the Delta, the Behera joins the more ancient Khatatbeh Canal. The Khatatbeh again joins the Mahmoudieh Canal about 67 miles further on, and as the length of the Mahmoudieh from the junction with the Khatatbeh, near Domanhour, to Alexandria is about 38 miles, the total length of this line of waterway from the Grand Barrage of the Nile at the head of the Delta to Alexandria is about 130 miles. The Mahmoudieh has a direct communication with the Nile at Atfeh, about 9 miles east of the junction with the Khatatbeh, and at this point pumping engines on a large scale have been supplied to feed the canal at Low Nile.

At High Nile the level of water at the head works of the canal averages about 56 ft. above the level of the Mediterranean, while the level of the lands at the same point is about 52 ft. above the same. At Khatnobeh the cultivated ground is 42 ft., and near Domanhour only about 18 ft. above the sea level. These places are on the left bank of the Rosetta branch, and not in the Delta proper, but the corresponding levels are much the same. Thus at Chibine el Kom the height of the lands above sea level is 43 ft., at Birket 33 ft., at Talah 31 ft., at Tantah 26 ft., at Kafr el Zayat 23 ft., and at Tel el Baroud 16 ft. It is obvious, therefore, how completely the flooding of the lands of Lower Egypt is under the control of any one holding the forts and barrages at the head of the Delta.

The barrage at that point across the Rosetta branch of the Nile is 1,535 ft., and that across the Damietta branch 1,787 ft. in length. In appearance the barrages look like a couple of great railway viaducts. The western one has sixty-one arches of 16 ft. 4 in. span, fitted with iron sluices about 15 ft. in height above Low Nile, and the eastern one has similar arches, but no sluices, the arches being closed temporarily by timber sheeting every year. Owing to the weakness of the foundation, it has been deemed imprudent to attempt to keep the sluices closed long after the Nile has commenced to rise, for the water might then back up some 15 ft. and exert great pressure on the structure. A reckless person, indifferent to the destruction of the barrage, might, however, close the sluices at any time, and so, by raising the level of the river, cause the water to rush down the Behera and other canals in enormous volumes at almost any time of the year, independent of the rise of the Nile.

The Menoufieh Canal, having its head works also at the barrage and supplying the Delta proper, is a far larger canal than the Behera, having a mean width of 250 ft. and a depth of from 21 ft. to 27 ft. at High Nile. When gauged with a depth of but 11 ft. of water in the channel, the velocity of the current was about two miles per hour, which is about as much as the light earthwork through which the canal is cut will safely stand. The discharge at that time was no less than 180 tons of water per second. If the full head of water were allowed to enter the canal, the torrent, scouring away the banks and bed, would rush down towards the sea, and flood the whole country. The barrage furnishes the means for attaining this result without waiting for the full rise of the Nile, and the works are defended by a strong fort situated between the two sections of the barrage and at present held by Arabi.

One of the largest canals in the Delta is the Bahr Chibine, an ancient branch of the Nile. To cleanse this canal is a formidable work, but it has to be undertaken every year, owing to the deposit of light silt and mud. When it is remembered that the whole of Lower Egypt is simply an accumulation of layers of Nile deposit, formed during the successive annual floods, it will be obvious that, unless the banks of the river and of the canals were repaired every year, and the canals themselves cleared of deposit, the whole country would soon revert to its primitive condition and be entirely submerged during about one-third of the year. Passive neglect would suffice, without active interference, to bring about the above state of affairs. Egyptians, like most other Orientals, are prone to trust to chance, and it is no matter for surprise, therefore, that they do not make the protection banks many inches higher than the anticipated level of the flood. During the exceptionally high Nile of 1874, thousands of fellaheen were kept at work day and night by the late Khedive in carrying baskets of earth to raise the banks at a rate to keep pace with the rapid rise of the Nile. Happily the work was accomplished, and a great disaster avoided.

From constant work on the canals the fellaheen are experienced in earthworks, and would take readily and naturally to the construction of entrenchments and fortifications generally. Again, the raised banks of the existing canals constitute so many lines of defence, if maintained, while if intentionally thrown down the land becomes flooded, and there is no clay or other suitable material available for repairing the banks. Many advantages, therefore, are enjoyed by the defenders of that compact little district known as Lower Egypt.

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RAILROAD CROSS-TIES.

Prof. L. M. Haupt read the following interesting paper on this subject before the Engineers' Club of Philadelphia, at a meeting held some time ago:

Cross-ties, as their name implies, are transverse connections between parallel rails. Their functions are various, viz., to preserve a constant gauge, to assist in distributing the weight of the passing train, and to connect the rails firmly with the surface of the ground beneath. In short, they are expected to hold the rails rigidly in place, both vertically and laterally. They are therefore subjected to both longitudinal and cross strains, and the selection of the most suitable material to resist these strains has been a live and important question ever since railroads were introduced. For the iron tie it is claimed that the cost price of wooden ties is sometimes three times the above amount. Every mile of new road tends to add to the value of the material used by increasing the demand and decreasing the supply, so that a solution of the problem which may have been the best in the early days of railroads may not always maintain its supremacy, nor be applicable under all conditions. The most suitable materials are those which fulfil all the conditions in the best possible manner. Aside from the mere rigidity already mentioned, there should be considered, economy in first cost and maintenance, facility of removal and repairs, elasticity, durability, simplicity of connections and safety. Much thought has been expended in attempts to satisfy these various and partially conflicting requirements, and the result has been the almost universal adoption of the well-known tie of hard wood.

While this may be the best material in parts of the country where wood is plenty or cheap, it is far from being universally applicable. So great is the demand upon our forests for ties, bridges, telegraph poles, fences, and for domestic and commercial purposes, that wood is becoming annually more scarce and dear, and its place is being supplied by less expensive manufactured materials, where it is possible to obtain them.

In some parts of the country the value of wood already exceeds that of iron and other substances, when the relative durability of the materials is considered. On some of the trans-continental railroads ties have to be carried nearly 500 miles, and are worth approximately 90 cents each, laid in track. But their life is only about six years, making constant renewals necessary. These facts have given rise to efforts to supply their places by iron or creosoted ties, by which the life and consequently the value of the tie will be greatly increased, and the cost of maintenance reduced.

If an iron tie can be made which will cost even a few cents less than the wood, it will ultimately effect an important economy not only to railroad managers and stockholders, but to the community at large, by reducing the demand for timber, by giving greater security, stability and by increasing the durability of the roadway, thus enabling trains to be run with increased velocity.

My attention has recently been called to a late patent for an iron railroad tie consisting of a broad flat bar of iron, the ends of which are enlarged under the rail and having flanges turned up on three sides, forming recesses for wooden cushions upon which the rail rests. The latter is keyed in place by a single iron or steel plate resting in grooves in the flanges, and against the web of the rail. The key is held by a tap-bolt running through the wooden block to the plate below.

The length of the wooden cushion in this tie is about 36 in., breadth 12 in., and depth not more than 3 in., making a volume for one tie of 2,520 cubic in., while for the ordinary wooden tie 8 ft. long, 6 in. deep and 9 in. broad, the volume is 5,184, or about twice as great.

As the bearing of these ties is 36 inches under the rail, it is evident that there will be a smaller number required than when wood is used with an average bearing of 9 in., but allowing the same length of interval for the iron as for the wooden ties, viz., 15 in., it would take only 1,242, as against 2,640, or less than half the number.

As the rail is a continuous girder held firmly by the clamps at each tie the strength of the intervening portion, according to Barlow, is increased one and a half times, and hence the space may safely be extended from 15 to 20 inches. The linear distance occupied by a tie and its interval would then be 36 + 20 = 56 inches, requiring only 1,131 ties to the mile.

The cost for one mile of road may now be compared.

From the report of Thomas D. Lovett, chief engineer Cincinnati Southern Railroad formerly, I find the following estimate:

2,640 cross-ties, at 40 cents	$1,056.00
360 joints, at $1 40	504.00
6,000 spikes, at $2 85 per 100, $171.00; but at 4 spikes to the tie this number should be 10,560, which at $2 85	300.96
Cost of distributing of material, laying ballasting, etc	2,150.00
	$4,010.96

This is in a country where timber is abundant. The per tie will not exceed $3. If this be true we will have—

1,131 × $3	$3,393
Ballasting, etc., as above	2,150
	$5,543

As compared with $4,011 for wood, and if the iron tie will outlast only two wooden ones, the ratio of iron to wood will be as 5,543 : 8,022.

It will be seen that this tie dispenses with all spikes and fish plates, avoids punching and holds the rail so firmly that there can be no danger of spreading from drawing loose spikes nor unequal settling, producing severe strains and shocks upon the rolling stock. Hence greater speed and safety would be attainable, and the injurious wear upon the ends of the rails by the present form of joint would be greatly reduced.

It should also be noted that old ties partially worn can be hewn down and used for a cushion.

CORRESPONDENCE.

THE METRIC CHAIN.

Arandas, Jalisco, Mex., July 21, 1881.

Editor Engineering News:

Upon reading some of the correspondence on the subject of the metric chain, it seems that the main difficulty lies in the attempt to introduce a unit of measure other than the chain. Let the chain be the unit of measure, and there is no more occasion for using the meter with it than there is for using the yard with the American chain.

For a year past, I have used a 25-meter chain, divided into 100 links, every tenth link marked—a chain similar in its division to the American chain, but of a more convenient length. Distances are recorded and stakes are marked in chains and hundredths, as when using the American chain.

C. H. Kluegel, C. E.

THE CANADA PACIFIC RAILWAY.

Canadian Pacific Railway,
Bow River Gap, July 9, 1882.

Editor Engineering News:

Your esteemed paper has reached me but three times in the last two months. I suppose it is because in this portion of the Queen's Dominion there are no mails except those carried by private enterprise. The military posts of Forts McLeod and Calgary have no public mails, and as all private mail passes through the hands of the mounted police, papers are not at all certain of getting beyond these posts.

The Canadian Pacific Railway have four parties of engineers at work in the Rocky and Selkirk ranges of mountains.

A cannot say anything in regard to the lines on the western slope. On the eastern slope a line is now being located, which follows the drainage of Bath Creek to Bow River, thence down Bow River until it reaches the open country east of the mountains.

The maximum grade is 75 ft. per mile on tangent, and extends about 6 miles from the summit. From this point the grade will not exceed 40 ft. per mile.

The sharpest curve is eight degrees, and grade is reduced on curves at the rate of 0.05 ft. per degree.

There have been two heavy snow-storms within the last two weeks. Very respectfully yours,

Frank P. Davis.

STAKING OUT SWITCHES.

Andover, N. J., Aug. 22, 1882.

Editor Engineering News:

I would like to ask the question, "What is the practical work for staking out a switch on the ground, frog being on the ground, and for the various ones now in use?" F. D.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 299.)

CCCLXXIV.—HACKETTSTOWN, N. J.

Hackettstown, New Jersey, in lat. 40° 50' N., long. 74° 50' W., is on the Muscooetcong River, in a valley between hills from 400 to 600 ft. high. The highest elevation in New Jersey is within half a mile of the town. Settled about 1750, it was incorporated as a town in 1853.

Water-works were built by the town in 1860, after plans of A. R. Day, taking the supply from springs and mountain streams on the south side of Schooley's Mountain.

The reservoir, about 100 ft. above the town, is of ¾ acre area. The water is filtered through sand, gravel and charcoal before entering the pipes.

Distribution is by 10 miles of cast-iron pipe of from 10 to 3-in. diameter, with 40 fire hydrants, 20 gates and 260 taps. Galvanized iron service pipes are used.

The population in 1880 was 2,600. No account is kept of the amount of water used.

The works have cost $54,000. The bonded debt is $54,000, at 5 and 7 per cent. interest. The expenses and maintenance in 1881 were $359.49, and the receipts $4,391.08.

The works are managed by a board appointed by the Town Council.

William Osmun is the Secretary and Treasurer, and Isaac W. Crane the Superintendent.

[TO BE CONTINUED.]

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NOTES.

The Nile Country.

The region on the west side of the Mississippi, between Vicksburg and the Gulf, gives a good idea of the Egypt through which the British will have to operate from Alexandria. It has the same feature of an annual rise of the river above all the country, which there begins in July, reaches its height in the latter part of August, and subsides through the autumn months. It has the same features of banks of the main river and of all the branching streams higher than the country, with the addition of canals, and of more complete banks, so as to flood the lands at will. All these may be made the means of obstruction and defense.

Mining at Panama.

Considerable progress is being made in reviving the mining industries of the Isthmus of Panama. For many years its mines excited the cupidity of Spaniards and buccaneers. Indians and negro slaves were made to work in quartz and placers by the most primitive processes, and almost entirely without machinery, yet their labors were very productive, according to tradition. It is centuries, however, since most of the mines were abandoned. Some were worked out, others were not rich enough to pay with hired labor, and all required an investment of capital which the unsettled condition of the country, and especially the fear all foreigners entertained for isthmus fever effectually prevented from being made.

The *North American Review* for September has for its leading article a very forcible presentment, by Dorman B. Eaton, of the evils produced by the practice of levying "Political Assessments." The paper is noteworthy for its striking array of facts, but more so because it will be universally regarded as the ultimatum of a large and influential section of the Republican party, addressed to the party leaders. "Oaths in Legal Proceedings," by Judge Edward A. Thomas, is a discussion of the question whether the interests of morality and of public justice alike, would not be promoted by the abrogation of all laws requiring testimony to be given under the sanction of an oath. Thompson B. Maury, late of the Signal Office, contributes an article on "Tornadoes and their Causes," which, in addition to its scientific interest, possesses the merit of suggesting many practical measures for averting disaster to life and property from windstorms. "Architecture in America," by Clarence Cook, is marked by a freedom of utterance that is refreshing. In this respect it deserves to rank with Commander Gorringe's celebrated paper on the United States Navy. Augustus G. Cobb writes of "Earth-Burial and Cremation," and J. F. Manning, in an article entitled "The Geneva Award and the Ship-Owners," sets forth the justice of the claims of consignors of cargoes and owners of vessels to indemnification out of the Geneva Award fund, for losses from the acts of Confederate cruisers. The *Review* is sold by booksellers and newsdealers generally.

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FLORIDA NOTES.

Work of construction on the Jacksonville, Tampa & Key West Railroad is being prosecuted near Tampa.

Locating parties are in the field near Palatka.

Major Gruelle, lately the Chief Engineer and Superintendent of the Florida Southern Railroad, has sued that company for $50,000 for damages.

Work on the Palatka & Indian River Railroad is temporarily suspended.

Work on the Cumberland Sound jetties is still being prosecuted, the old appropriation not being yet exhausted.

The new dredge of the Atlantic & Gulf Coast Canal & Okeechobee Drainage Co., which has been building at St. Augustine, is nearly ready to be launched. It will be employed in cutting a canal between the Montanzas to the Halifax rivers. It will cut a channel 28 ft. wide and 4 ft. deep.

A railroad is proposed from Jacksonville to Fort George, at the mouth of the St. John's River.

The wharf of the Jacksonville, St. Augustine & Indian River Railroad, opposite Jacksonville, is being rapidly constructed, and work on the line is progressing favorably under Mr. S. B. Sneaden, Chief Engineer.

A new railroad is being surveyed from Jacksonville, Fla., to the sea beach, about twelve miles. It is intended for a narrow gauge, and the projectors propose to build a large hotel on the beach, and open a sea-side resort, much needed by the Jacksonvillians.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Dean Bros. Steam Pump Works, Indianapolis, are building two pair of pumps for the Indianapolis Water-Works. They will be driven by water power, two 48 inch American Turbine wheels will be used.

Sanford, Fla., is agitating water-works. The city has voted to pay $1,000 for water furnished for city use alone, the first year.

Palatka, Fla., is having surveys and estimates made for a water supply. An excellent source of supply is conveniently available in a cool and swift running brook, and a fine site for a reservoir is found on a hill near the city.

Elk Rapids, Michigan wants water-works, and $1,500 has already been subscribed for the purpose of laying the mains and building the works. The amount wanted is $4,500.

The "Pulsometer Steam Pump Co." New York, Boston and Chicago have recently filled a telegraphic order from Portland, Oregon, for three of their largest "new pulsometer steam pumps" for use on the Northern Pacific Railroad, also one for California for a 130,000 gallon per hour pump, also one from Denver, Colo., for a large one to be shipped by express. This company is daily in receipt of telegrams for pumps. They have recently shipped several to South America and Mexico for irrigating purposes, and are now filling an order for six from Cuba for plantation sugar-house pumping.

Their business is increasing 100 per cent. every three months, which necessitates constant increase of manufacturing facilities.

Bradford capitalists talk of forming a company to transport natural gas from the Northern oil fields to all the leading cities, East and West, for illuminating purposes.

An Opportunity for Inventors.—The New Orleans Water-Works Co. are prepared to enter into negotiations with parties who are able to solve the problem of thoroughly removing from the Mississippi water all the sediment contained therein, so as to render it fit to drink. The officers of the company believe that some apparatus can be found that will filter the water at the suction pump before entering into the pipe. For any such device they say that the company can afford to pay a liberal sum of money. Address correspondence to R. A. Ducros, No. 60 Carondelet street, New Orleans, La.

Pipe laying is being pushed ahead by the water-works company, and a great deal of work has been accomplished on the grounds near the Cedarville bridge.—*Freeport (Ill.) Journal.*

Citizens of South Evanston, Ill., are considering the matter of water-works. The village Council has, however, declined the offer of Evanston to furnish water at $80 per 1,000,000 gallons, provided not less than 3,000,000 gallons per month were taken. An artesian well is also talked about.

At the Water Registrar's Office.—A citizen called recently at the Water Registrar's office and introduced himself and his business by saying, "I'm Misther Jerry Muldoon. My cellar is full of water, and my hins will be drowned if it isn't fixed; so I want you to fix it."

Mr. Muldoon was informed that nothing could be done for him there. Two or three days later he reappeared. "I come again to see about that cellar," said he; "it's worse than ever." "But we told you the other day, Mr. Muldoon, that we can do nothing about it here." "Yes. But my cellar must be fixed or my hins will all be drowned." "Well, Mr. Muldoon, did you see the mayor about the matter?" "Indade I did," replied Mr. Muldoon. "And what did the mayor say?" "What did he say, is it? 'Misther Muldoon,' says he, 'why don't you kape ducks?'"—*Boston Journal.*

Commissioner Hubert O. Thompson has transmitted to the Mayor the report of the operations of the Department of Public Works for the three months which ended on June 30, 1882. The department collected in the quarter, $538,181.81 from water rents and other sources; expended on public works $1,188,156.19, and awarded 112 contracts for work, the estimated cost of which is $1,605,282.28. The length of the sewers south of the Harlem River is 386[illegible] miles, and there are 4,617 receiving basins. The department during the quarter built 10,434 lineal feet of sewers, 313 ft. of culverts and 11 receiving basins, and rebuilt and repaired several sewers. One hundred and thirty-two gas lamps and 17 electric lights were added to the street and park lamps, the eight public baths were placed at their stations on June 1, and a new bath was put at the foot of Laight street.

Asheville, N.C., is building water-works. C. L. Freeman, formerly connected with the Washington (D.C.) water-works, is Constructing Engineer.

Quincy's New Reservoir.—The reservoir of the water-works company is almost entirely completed. It already contains a water supply, but the finishing touches are just now being given to the embankment to make it attractive and pleasing to the public. These include sloping and sodding of the exterior, which is being done rapidly. It has been almost a year since the construction of the reservoir was commenced. The reservoir occupies almost an entire block, and the magnitude of the work of building it may be gained from a few statistics submitted. Aside from the great amount of earth and gravel, there were used in its construction 4,000 cubic yards of stone. The distance around the crest is 1,650 ft., it having a total slope of 40 ft. and an elevation of 96 ft. to the point of overflow. At the base the embankment is from 90 to 110 ft. thick, the bank at high-water mark measuring 27 ft., and the crest 15 ft. in width. The materials of which the embankment was constructed were laid in 6-in. layers, and then rolled with a corrugated roller weighing 4,700 lbs., thus making it absolutely water-tight. The capacity of the reservoir is 21,000,000 gallons, and it now contains, with the gauges at 12 ft. 6 in., a little over 12,000,000 gallons. The elevation is so great, and the pressure is so strong, that a hose attached to a fire-plug in the center of the business portion of the city would be enabled to throw a stream to the top of any business block thus far constructed. The water it supplies is unusually clear, but a still further improvement in this respect will be made as soon as the dredging for the river main is finished. Meantime, many details of closing small gaps and interstices are being attended to, and a force of workmen is rapidly sodding and beautifying the embankment. The water-works company has expended an enormous sum of money on this work, and has finally provided an ample supply of water, with pressure enough to meet any probable emergency.—*Quincy (Ill.) Whig.*

ELECTRICITY.

Nassau Street Horses Shocked.—About a thousand people collected in Nassau street, between Ann and Fulton streets, on Thursday, attracted by the astonishing conduct of the horses that were driven toward a certain point in the roadway. One particularly dejected looking horse, that walked along slowly, no sooner reached the mysterious spot than it reared, pawed the air for a moment and then started off at a speed that fairly took away the driver's breath. Several other animals acted in a similarly inexplicable manner, to the alarm of the drivers and astonishment of the spectators. One truckman fell from his seat, but sustained no injuries. It was at length discovered that a discharge of electricity under ground was the cause of the trouble, the electricity communicating with the horses through their iron shoes. A policeman gave early notification of the disturbance to the officials at the Edison Company's office and the current was cut off.

"You see," said Mr. Edison, who stood by, cigar in mouth, watching operations last night, "excavations are made from time to time for the laying of steam-heating pipes, and these cause us no end of trouble. Our conductors become undermined and get pressed down upon the pipes, so that when a heavy truck passes along there is a jar and an electric shock is the result. We are getting at the bottom of this thing and it will be remedied speedily and without difficulty."

Electric Railway Development.—The development of electric railways and tramways is now considerable. Putting aside numerous lines that are merely talked of or projected, those which are working, authorised, or in course of construction show a total length (according to the *Revue Industrielle*, July, 19) of 160 kilometers—i. e., about 100 miles, and grants are becoming even more numerous. The lines actually at work are those of Lichterfelde (about 2 kilometers in length), and that from the Spandauer Bock to Charlottenberg, near Berlin; another line, from Port Rush to Bush Mills, in the North of Ireland, has been inaugurated (length about 10 kilometers), and also in Holland, one from Zandvoort to Kostverloren, (length a little over two kilometers). Among lines authorized or in construction, the following are noted: In Austria, the Mœdling line, near Vienna (2½ kilometers), to be constructed by the Southern Railway Company there. In Germany, the line from Wiesbaden to Nürnberg (2 kilometers), and that from the Royal mines of Saxony to Zankerode. In England, a line under the Thames, connecting Charing-Cross and Waterloo stations (1.2 kilometers); also a line in South Wales (60 kilometers), for which the force will be derived from fall of water. In Italy, Turin and Milan will soon begin the construction of electric tramways. In America the Edison Company have arranged for the working of 80 kilometers on one of the great lines from New York. Another small line (1.8 kilometers) is to be made at St. Louis, in Missouri, by Mr. Heisler.—*London Times.*

RIVERS AND HARBORS.

A board of officers of the corps of engineers to consist of Lieut. Col. David C. Houston, Major Jared A. Smith, Major William H. H. Benyaurd, will assemble at Chicago, Ill., on the call of the senior member, and as soon as the other duties of the members will permit, to examine the Calumet River, Ill., "and report upon the practicability and the best method of perfecting and maintaining a channel for through navigation" to the fork of said river at Lake Calumet, "adapted to the passage of the largest vessels navigating the northern and northwestern lakes," and to limit and locate the "lines of channel to be improved by the United States, and of docks that may be constructed by private individuals, corporations, or other parties," and clearly define the same. The board will further report "the estimated cost of the proposed improvement, also what legislation, if any, is necessary to prevent encroachments being made or maintained within the limits of the channel designated" as provided for in the River and Harbor Act of August 2, 1882. The board will make its report in time to be received at this office on or before the 20th of November next. On completion of the foregoing duty the members of the board will return to their stations.

A Board of Officers of the Corps of Engineers to consist of Col. Charles S. Stewart, Lieut.-Col. George H. Mendell, Lieut.-Col. William P. Craighill, Lieut.-Col. Cyrus B. Comstock and Capt. Charles F. Powell will assemble at Astoria, Or., on the 12th day of September next, or as soon thereafter as practicable, "to examine in detail the mouth of the Columbia River, Oregon, and report such plan with estimates for its permanent improvement as they approve," as provided for in the river and harbor act of Congress of the 2d inst. The board will make its report in time to be received at this office on or before the 20th of November next. On completion of the foregoing duty the members of the board will return to their stations.

A Board of Officers of the engineer corps, consisting of Lieutenant-Colonel David C. Houston, Major Henry M. Robert and Major Wm. H. H. Benyaurd, has been appointed to meet at Oshkosh, Wis., to consider and report upon matters provided for in the river and harbor bill concerning the channel of the Lower Fox River between Lake Winnebago and the upper government dam at Appleton and to the dams at Menasha and Appleton. The board of officers of the engineer corps appointed in 1880 will reconvene at St. Paul, Minn., and reconsider their former report and recommend any change in design or dimensions of dam at the outlet of Lake Winnibigoshish on the Mississippi River. Major Alexander McKenzie is detailed as member of the board in lieu of Major G. J. Lydecker, not now available.

Philadelphia, Aug. 17.—Representatives of the commercial organizations of this city have adopted resolutions approving the action of the Philadelphia delegation in Congress in securing the amounts appropriated for improvement of the Delaware River and bay.

New Channel at Mobile.—The 17 ft. cut channel was completed on the 21st, and Mobile now has 17 feet of water at low tide from the wharves to the sea.

STREETS, DRAINAGE, ETC.

The streets of San Francisco are written up (or down) in a half-page article in the *Chronicle* of the 17th.

RAILROADS.

At the annual meeting of the Tennessee Southern Railroad stockholders the following officers were electected: R. T. Wilson, of New York, President; Eugene Martin, Vice-President; James M. Edwards, General Manager and Assistant Treasurer; John A. Grant, Chief Engineer; C. H. Boeber, Treasurer. It was decided to put a corps of engineers in the field at once, and let contracts for construction south from Memphis towards Vicksburg as soon as practicable. It is proposed to open the line from Memphis to New Orleans within the present fiscal year. The question of consolidation with the Memphis & Vicksburg, the Mississippi Valley & Ship Island and the New Orleans & Mississippi Valley was postponed for sixty days.

The stockholders of the Scioto Valley road have decided to extend it from Columbus, O., to Fort Wayne, Ind., and for this purpose they have voted to increase the capital stock from $5,000,000 to $10,000,000, and to authorize an additional issue of bonds not exceeding $25,000 per mile, or $1,500,000. The stock now issued is $2,100,000, and the increase from this is to be only in proportion to additional construction. The line is intended to give the Chesapeake & Ohio a means of reaching Chicago.

A Sudden Rise in the Rio Grande River, on the 21st carried away a part of the Great Northern railway and a part of the Mexican national bridges. This will prevent rail communication with Mexico for several days, though the damage is not detrimental to traffic.

The Indianapolis Rolling Mill Company has received an order from the Erlanger system for 4,600 tons of rails to be used on their Memphis, Selma & Brunswick branch.

As our railroads increase in length the rails follow their example. At one time the rails in general use were only 16 ft. long, then 32 ft. became the standard. Sixty-feet rails have been in use for a long time, and a new mill in Chicago is prepared to turn out rails 120 ft. in length. The advantages claimed for the longer rails are that they present fewer joints to be battered down by the wheels and to react upon the latter. The rails are also made much heavier per foot now than they used to be to withstand the heavier rolling stock now employed.

A Houston (Tex.) despatch says: "At the called meeting of stockholders and directors of the Texas & New Orleans Railroad a resolution was passed increasing the capital stock of the road from $3,000,000 to $5,000,000. This was done for the purpose of spreading the Texas & New Orleans stock over the Sabine & East Texas Railroad, which heretofore has had no bonded debt, and is now to be purchased by the Texas & New Orleans road. A resolution was also passed authorizing the Texas & New Orleans road to effect a loan of $2,575,000 at 6 per cent. interest, for the purpose of constructing, owning, maintaining and operating a Sabine Beynich Division, running from Sabine Pass, via Beaumont, in Jefferson County, and Woodville, in Taylor County, to a point on the Neches River at or near Burr's Ferry, a distance of 103 miles, the bonds on said road not to exceed $25,000 per mile of completed road.

At a meeting of the main stockholders and directors of the Sabine & East Texas Railroad, A. H. Vile, Vice-President, Director and Auditor, tendered his resignation, which was accepted. A. F. Smith was appointed Auditor, and Assistant Secretary F. McReynolds was elected Director to fill the vacancy. The Sabine & East Texas Railroad will be completed in twenty days from Neches River to Sabine City, only 4,000 yards of grading remaining to be done.

Inspecting the Cable Railroad of Chicago.—Mr. Adolph Schreiber, one of the leading business men of New Orleans, and Mr. Henry Wolters, the well-known architect, have been in the city for a few days past inspecting the cable road. Mr. Schreiber is the president of the New Orleans Cotton Compress & Warehouse Company, an association recently formed which will be the largest of its kind in the world. Its property will consist of six immense warehouses, on the banks of the Mississippi, opposite New Orleans, with floating docks, steam and cable railways, presses, cranes and every modern facility for handling, compressing and independently storing from 1,500,000 to 2,000,000 bales of cotton annually. The works will cover an area of 400 acres, which have been already purchased. They will cost $1,500,000, and will receive the staple from steam trains and river boats and be able to load it on anything from a hand-car to the largest ocean vessels that run to the Crescent City. The gentlemen have been studying the cable road here, with a view to using it to transfer cotton from vessels and steam cars to any section of the warehouses, and, having seen how entirely successfully it does its work here, they have no doubt that it is exactly what they require to perform that duty in their yards. The Compress Company is in the hands of men who never make a failure of anything, and the belief is expressed among well-informed people here that the methods which they propose to introduce, especially with the cable system and other machinery which they intend to use, will not only effect a heavy reduction in the cost of handling, but will be the beginning of a revolution in the manner of doing that kind of work in the south.—*Chicago Times.*

Chicago & Atlantic Railroad.—The officials of the new line to be built along the tow-path of the old Wabash and Erie Canal state that work on the road will soon begin, and the track between Peru and Logansport will be laid this fall. It is possible that it will be extended to Wabash before January, 1883. It is to be built to Fort Wayne and Lafayette next summer.

The grade and bridges of the Chicago & Atlantic Railroad through Wabash County are now completed and ready for the ties. Track-laying will soon commence, and it is the intention to have trains running to Chicago by November first.

The Cost of Stopping a Train.—Professor S. W. Robinson, acting for the Ohio State Commissioner of Railroads, on the 17th began an inspection of the road and bridges of the New York, Pennsylvania & Ohio. In his recent work on railroad economies, his estimation on the losses for stopping at intersections, is rather interesting. He has calculated the cost for stopping a train, and puts the average at $1.77.

Blasting Along the Hudson River.—Heavy blasts are now the order along the line of the West Shore Railroad. They are one of the results of the determined effort which is being made to finish the road as soon as possible. But the biggest blast that has yet been set off anywhere on the river was one which was fired at 4 p. m. on Sunday, at Hampton Point, on the Smith Brothers' contract. A hundred and forty five kegs of powder were used, and about 3,500 cubic yards (or more than 7,500 tons) of rock were thrown over into the river. The blast will be worth about $2,000 to the Smith Brothers, but if it had failed from any cause they would have been "out" quite a sum. One of the blasting incidents that they tell about up the river is a little odd. A stone about the size of a water-pail was thrown a long distance. It descended through a house down to the main floor, and rebounding there without breaking the flooring, it went up on a bureau. The bureau was comparatively uninjured, but the people, who were in another part of the house ran to the room where they heard the noise, looked about for some time before they saw what had made the disturbance. They then discovered the stone on the top of the bureau.—*Newburg Journal, Aug.* 14.

A Madison (Wis.) despatch says: "Articles of incorporation of the Markesan & Brandon Railway Company were to-day filed with the Secretary of State. The road will run between Brandon and Markesan, a distance of 12 miles. It is rumored here that the above section is the forerunner of a road which will connect Portage with Brandon in the interest of the Chicago, Milwaukee & St. Paul line, thus uniting its branches and giving that road more direct connection with the northwestern portion of the State."

Those who are interested in the Ottawa, Waddington & New York and the Pontiac & Pacific Junction Railway companies have for some time past been considering the subject of an amalgamation. Correspondence has already passed on the subject.

The Ellendale & Wahpeton Railroad is the title of a recently organized company in central eastern Dakota. The line is to run from Ellendale, Dickey County, Dak., the present northern terminus of the Hastings & Dakota Division of the Chicago, Milwaukee & St. Paul Railway, eastward through Dickey, Ransom and Richland counties to Wahpeton, a prominent town on the St. Paul, Minneapolis & Manitoba Railroad, on the eastern boundary line of the Territory. The estimated length of the road is 100 miles. Capital stock, $250,000.

Articles of incorporation of another railroad have been filed in the office of the Secretary of State of Arkansas. It is to run from Van Buren, the crossing point of the Frisco and Fort Smith roads, south to Texarkana, the southern terminus of the Iron Mountain road. This will take it through the mineral regions of Arkansas, crossing Crawford, Sebastian, Scott, Polk, Howard, Sevier, Little River and Miller counties, a distance of 150 miles. The capital stock is fixed at $1,500,000, being $15,000 shares of $100 each. All the stock taken is held by citizens of Van Buren, except $3,000, which appears in the name of J. E. Johnson, of Kansas City.

General Manager Taylor, accompanied by Chief Engineer True, of the Canada Southern, have been examining a projected line from Windsor to Essex Centre, Ontario, which will shorten the distance between the east and west seventeen miles, making the line shorter than via the Grand Trunk. The probabilities are that this cut-off will now be built to offset the improvements contemplated by the Grand Trunk. The Vanderbilt people are known to be negotiating for terminal land for such a line.

A Gigantic New Depot for Chicago.—Chicago, August 17.—As a result of the recent interview in the east of Presidents Ackerman, Cummings and Vanderbilt, it had been decided that the Illinois Central Railroad shall give up its long contest with the city for two blocks of land on the lake front and at once begin the erection of a depot where the ruins of the former depot, burned in the great fire of October 9, 1871, still stand. It will cost over $500.000, and will be completed in 1883. It will be jointly occupied by the Illinois Central, the Michigan Central, the Baltimore & Ohio and the New York, Chicago & St. Louis railroads.

The gross earnings of the Norfolk & Western Railroad Company for July were $191,584.73; expenses, including estimated proportion of yearly taxes, $106,-793.02; net earnings, $84,741.71, being an increase as compared with July, 1881, of $8,880.01. The gross earnings for the seven months of 1881 were $1,216,494.-27; expenses $717,292.16; net earnings, $459,202.11, being a decrease as compared with the corresponding period of last year of $35,681.67.

Indians Opposed to the Progress of Railways.—Ottawa, Aug. 17.—A trader from the Northwest announces that the Cree Indians are much discontented at the inroads which the various projected railway lines will make into their hunting ground, and threats are freely made against the surveyors who may begin operations on their reservation. They will, however, remain on the Canada side of the line.

The last of the surveys of the Louisville Southern, President Standiford's, will be completed the present week. Immediately afterward the engineers will return to Louisville and make up estimates. When this is finished the public will be apprised of the exact location of the road.

A New Railroad.—Washington, D. C., August 22.—A new railroad company has been incorporated, which will form a Western connection with the Chesapeake & Ohio Railroad, and will commence in or near the city of Charleston, W. Va., on the north side of the Great Kanawha River. The capital stock of the company is $1,-200,000.

Many people are anxious to know how the work on the New York, West Shore & Buffalo Railroad is progressing. Between Weehawken and Middletown, and between Cornwell and Syracuse, they have 17,640 men, 118 steam and compressed air drills, 14 steam excavators, 8 dredging machines, 2,068 horses and carts, 80 locomotives, 995 cars, 19 spile drivers, 69 steam derricks, 9 steam pumps, and 29 tugs, scows and canal boats.

Surveys are being made on both sides of Coal River, in West Virginia, to ascertain the best grade for the St. Albans & Boone County Railroad.

CANALS.

The Hennepin Canal.—Secretary Lincoln has ordered the engineers to begin at once a survey for the Hennepin Canal. It is hoped by its friends that the engineer's report will be here when Congress meets again. An attempt will be made to secure an appropriation of $500,000 for the first year, and of a like sum annually for years to come. There will be a bitter fight in Congress over the appropriation, which will be demanded if the Hennepin Canal people succeed in getting a favorable report from the engineers.

CONTRACTS LET.

Street Paving Contracts Let.—On July 18, Wm. B. Knight, City Engineer of Kansas City, Mo., received proposals for paving Sixth street, for a distance of 2,850 ft., an area of about 7,500 sq. yds. Advertised in Engineering News of July 15. The following bids were received :

	Price per sq. yd.
Jas. McGonigle	$3.00
Jas. Pryor	3.18
Benj. Taylor	2.98
J. D. Smith & Co	3.05

Awarded to Jas. Pryor.

On the same day bids were received for paving Fifth street a distance of 2,200 ft., an area of about 5,900 sq. yds. The following bids were received :

	Price per sq. yd.
as. McGonigle	$3.30
Benj. Taylor	3.25
J. D. Smith & Co	3.65

Awarded to Benj. Taylor.

A Nebraska Contract Let.—The contract for furnishing lumber and building materials for fifty new houses to be built for the Indians on the Santee agency has been awarded E. P. Wilcox, of Yankton, for about $10,000.

The Bureau of Construction and Repairs of the Navy Department has awarded contracts for furnishing lumber and various other supplies for the navy-yards throughout the country to the following firms: Joseph D. Fransoni, Robert Boyd, Joseph L. Savage, Johnson Brothers, William P. Dempsey, L. P. Brown, Wheatley Brothers, Bernard Bailey, W. B. Moses, and Francis Miller, of Washington; P. J. Field and J. B. Shannon, of Philadelphia; Rider & Catlon, of Portsmouth, N. H.; George L. Neville, Portsmouth, Va.; George H. Creed, New York; Collender & Co., Boston; A. A. McCullough, Norfolk, Va.; Berry Brothers, Detroit; James Duffy, Scofield & Terris, G. T. Hardy, S. H. Frank & Co., and Lake & Warren, San Francisco; A. Powell and James McCudder, Vallejo, Cal.; D. Babcock & Co. and James W. Duryee, New York; Pope & Cole, Baltimore; George A. Hammond, Eliot, Me.; William White & Son, Portsmouth, Va.; Charles E. Walker, Portsmouth, N. H.; A. H. Lindsay, Norfolk, Va.; John Street, Jr., Philadelphia; Eppinger & Russell, New York; J. W. Gaskill & Sons, Philadelphia; R. A. Robbins, New York, and H. S. Crocker & Co., San Francisco.

Contracts have been let for a branch of the N. Y. C. & St. L. road, from Toledo to Allegan, Mich., 150 miles in length. It connects with the Chicago & Western Michigan road, and will give access to Grand Haven and other lake ports. It will take the coal off the Ohio Central road into all the Northwest.

Pipe Contract.—The contract to furnish the pipe for the water-works at Knoxville, has been awarded to the Chattanooga Foundry and Pipe Works. The length of pipe is 9 miles, and will cost in aggregate $83,000. The total weight will be 900 tons. There is but one other larger water-works contract given in the South, that of Nashville, which was awarded a Louisville factory.

Ohio State-House Contracts.—D. Connelly, Cleveland, boilers, $4,328; William Saint, Dayton, carpenter work, $827.50; Rand & Sweetman, Dayton, paving and concrete, $2,235; A. Schwartz, steam-pipes, $644.-50; Kelly & Co., gas and water-pipe, $824; C. Mahoney, masonry, $1,248.65; W. R. Kinnear & Co., sheet metal and iron, $2,441.70.

BUILDINGS.

Market.—A public market-house is to be built in Omaha, Neb., costing $200,000.

Building operations are brisk in Holyoke, Mass.

The Curtis Pressure Regulator is used on the heating apparatus, drying-room and steam pumps of the Para Rubber Works, Framingham, Mass.

About forty bids have been opened by architect Boyington for furnishing granite for the new Chamber of Commerce at Chicago, and for doing the mason work. No decisions have been reached.

A new city hall is to be at once erected at Racine.

Plans for sewers in first ward, Racine, have been adopted.

Contractors and carpenters and builders are having a harvest, as buildings are going up on every hand at Racine, Wis.

The contract for painting the roof of the Department of Justice was to-day awarded to W. L. Lemon, of Washington, for $200. The contract for plastering the new court house at Danville, Va., was to-day awarded to Joseph Eastman, for $2,268.

A $30,000 opera-house is to be built at Bethlehem.

The County Court of Claims at Lexington, Ky., has appointed Hon. W. B. Kinkead, R. J. Sparr and Professor A. Drake a commission to prepare and sell the bonds of the county for $100,000 to build a new court-house. The bonds will bear 6 per cent. interest.

BRIDGES.

Cleveland's Great Drawbridge Span.—Yesterday, at 6 o'clock p. m., the connecting link between the east and west of Cleveland, on the New York, Chicago & St. Louis Railroad, familiarly known as the "Nickel Plate" road, was completed by the swinging of the drawbridge span over the Cuyahoga River into place. The weight of the span is 200 tons, its length 225 ft., and its height above the river 67 ft. It was built by the Cleveland Car and Bridge Company, in accordance with plans designed by Mr. W. M. Hughes, designing and supervising engineer of bridge construction of this portion of the Nickel Plate road. Over 100 sheets of detailed drawings were required in its construction. The draw will be operated by steam power, but was temporarily moved by hand power yesterday. It required four minutes by the watch to move it around, and Mr. Hughes says that when the machinery by which it will be operated is in place and ready to be put in motion it can be turned in one minute. When the massive structure was moved for the first time, and, obedient to its motor power, swung around easily without friction or jar, the satisfaction of Messrs. Hughes and Claflin, designers and builders, who were anxiously watching it, was too apparent for any doubt. Some idea of the immensity of the viaduct can be derived from the following: Its total length is 3,000 ft.; total weight, 2,500 tons, with a double track surface the whole length. It is less than a year since the first lines and figures were marked for the structure. It is expected that within the next two weeks it will be in readiness to run trains over, as the most particular and important part of the whole work was completed in the swinging of the draw span into place. Mr. Hughes made for himself a reputation to be proud of in the work he did on the Cincinnati Southern, and he has added to it beyond compare by the magnificent specimen of draughtsman and engineering skill displayed on the great viaduct over the Cuyahoga River and flats. The Cleveland Car and Bridge Company also, who have built one-half of this magnificent structure, including the draw span, are entitled to a justly earned encomium for the ability and readiness displayed in turning out such work. It is not saying too much, indeed, to claim a good deal for the Forest City on the score of her having such an establishment as the car and bridge works within her limits.—*Cleveland Herald, Aug. 19.*

The Corrugated Metal Co., of East Berlin, Conn., are running their works 22 hours per day, and employ 150 men inside and about 50 outside. They have lately received a contract for a double-track railroad bridge on the N. Y., N. H. & H. R. R. at Cos Cob, Conn., comprising 3 fixed spans of 120 ft. each and a draw span of 160 ft.

Bridges Damaged.—The following despatch was received at the New York office of the Mexican National Company from the chief engineer of the Northern Division:

"Laredo, August 22, 1882.

"*G. C. Gardner, New York:* One hundred and fifty feet International Railroad Company's bridge gone, including iron span. Our bridge, Mexican National, slightly damaged. Will be able to cross to-morrow.

"S. T. Fuller."

Pittsburgh's Proposed New Bridge.—If all the bridges projected across the Monongahela be completed, that river within the limits of the city will be spanned by a net-work. Still another is being agitated. Ten or eleven years ago a company, of which Mr. James McGinnis, of the Fourteenth Ward, was President, obtained a charter for one to be known as the Fifth avenue bridge, to extend from the bluff at the head of Miltenberger street to South Seventeenth and Wharton. Nothing further was done. Last week, however, the project was revived by the parties interested, and there seems to be a fair prospect of it being carried to completion. The total length of the bridge, if built according to the plan, will be 1,174 ft., divided into two spans of 500 ft each, one span of 250 ft., and one span of 221 ft., and the grade will be 3 ft. to the hundred from the south side to the bluff at Miltenberger street. The frame-work will be of wrought iron, and will be supported by steel wire cable 2½ in. in diameter, and with an aggregate strength of 2,240 tons. There will be a double roadway of 18 ft. wide, and wide sidewalks for foot passengers. The drawing was made by Mr. Roebling, and is now on exhibition at the office of the Excelsior Glass Company, on Miltenberger street.—*Commercial Gazette.*

The Massillon Bridge Co., at Massillon, O., has just completed a bridge over Tanner's Creek, near Indianapolis, for the Cincinnati, Indianapolis, St. Louis & Chicago road.

Clarke, Reeves & Co., at Phœnixville, Pa., have on hand the following bridge contracts: Schoharie bridge, 3 spans, each 163 ft. 1½ in.; Glenaire, 1 span, 158 ft. 1½ in.; Kentucky River bridge, 1 span, 300 ft.; 1 span, 250 ft.; Two Mile Creek viaduct over Kentucky River; viaduct and tower for Rondout Creek bridge; Galveston, Harrisburg & San Antonio bridges, consisting of 27 spans, total length of which will be 4,605 ft.; Blank Creek bridge, 1 span, 98 ft.; Glendrie bridge, 2 spans, 98 and 84 ft.; Grand River bridge, 4 spans, 81 ft. 6 in.; McGregor's Creek bridge, 1 span, 122 ft.; W. B. Wilkins bridge, in Brazil, 2 spans, 185 ft each; approaches to Rondout Creek viaduct, 120 ft. span; Susquehanna bridge at Sunbury, 10 spans, 195 ft. each. They have also 6 spans of bridges, 167 ft. each, one 108 ft. 6 in., and one 97 ft. 6 in., the names of which were not given.

Thames River Bridge.—The New Haven (Conn.) *Register* says: "It may be said that the railroad bridge over the Thames has become a fixed fact, and the excitement that arose among New London people regarding it last winter has largely died away. The engineers have located its site, and it is understood that work on it will soon commence. It is said that the survey shows 100 ft. of mud and water on the proposed site, and that the bridge will cost $3,000,000 at the lowest. It is, perhaps, noteworthy that the surveyors and officers of the Thames Bridge Company occupy part of the office vacated by the New London Northern Railroad Company, which was the strongest opponent of of the bridge scheme."

The Progress of the Brooklyn Bridge.—President Murphy, on the 23d, sent the following information to Mayors Low and Grace, giving the details of the work on the bridge during the past week: "The following parts of the bridge have been put in place during the past week: 144 intermediate chords, 72 diagonals, 60 posts, 21 intermediate promenade floor-beams, 12 lower-chord sections and 2 upper-stay bars. On the Brooklyn approach preparations are being made for the building of the foundations for the iron viaducts and station building. On the Franklin square bridge the material for truss E, the fifth, is being connected. The upper chords are nearly riveted together. The material for truss F, the sixth and last, is mostly on the ground, and also for the railings of trusses A and B, and a portion of them is being erected. Thirty-two tons of steel have been delivered by the Edge Moor Iron Company during the past week, leaving still some diagonals for panels from 13 to 20 to come before the erection of trusses can be proceeded with."

An Iron-Clad to be Broken Up.—Portsmouth, N. H., August 22.—The unfinished second rate iron-clad Massachusetts, on the stocks in this navy yard, is to be broken up. She was commenced near the close of the war, and represents an outlay of about $2,000,000.

Surveys.—Out of the appropriation of $400,000 contained in the sundry civil appropriation bill for surveying public lands Acting Commissioner Harrison has made the following apportionment among the various surveying districts: Arizona, $10,000; Colorado, $30,-000; Florida, $5,000; Minnesota, $20,000; Nebraska, $15,000; Oregon, $30,000; Utah, $30,000; Wyoming, $20,000; California, $25,000; Dakota, $40,000; Idaho, $15,000; Montana, $30,000; New Mexico, $20,000; Nevada, $20,000; Washington, $25,000; Louisiana, $15,000—total, $350,000. The act provides that $50,-000 of the aggregate shall be reserved for the examination of surveys made and the department reserved the balance ($20,000) for emergencies.

THE HUDSON RIVER TUNNEL—THE NEW YORK WORKS.

Tunneling by compressed air, as illustrated in the subject under consideration, may now be considered as one of the means placed at the disposal of the engineer by which he may accomplish his aims. The work already finished, and especially the character of this work, entitles it to this position, even if no further advance should be made. It was a bold innovation upon long-established rules and theories, but in the future its peculiar adaptability under certain conditions will render it of inestimable value. As in the case of many other new plans for doing hard work, the difficulties encountered and overcome could not be anticipated—certain known laws existed which could be made subservient; also certain unknown conditions appeared which the teachings of experience alone could master. Under a combination of these two features progress could only be made by the exercise of extreme caution and a vigilant watchfulness, ever ready to profit by the outcome of the hour.

Had the tunnel advanced through the same material at all stages, no change would have been necessary in the plans, except such as might be considered as improvements upon those in vogue. But substances have been found which varied widely, and even the same material has been found which presented many different aspects. This has been particularly noticeable in passing through the silt on the New Jersey side; in general it is so compact as to present an almost perfect barrier to the escape of the air; in the other cases it is so soft as to permit of a much too ready passage of the air. Sand and gravel have been met, and under conditions which have but seldom been analogous. It might, in fact, be stated that in the building of every section of the tunnel a practically new material has been discovered. That a plan works successfully in one section or instance is no guarantee that it will work equally well in the next, and, as a natural consequence, new methods and devices that would fit the case in hand have had to be thought out.

Another prolific cause of annoyance has been the utter impossibility of estimating, by calculation, the amount of air pressure required for the best interests of the work. A pressure per square inch equal to the hydrostatic head could be readily obtained, but in most cases it would not suit the characteristics. The earth surrounding the tunnel may be considered as an envelope or skin whose minimum thickness is the distance from the roof or arch to the bottom of the river. A variation in the density of this skin, no matter how slight; a difference in the upper vertical thickness; the specific gravity of the mass; the porosity of that portion immediately adjacent to heading; all these circumstances have combined to influence the air pressure requisite, and have compelled its determination by actual trial and experiment and not by mathematical process. As success depended, in a certain sense, upon a true equilibrium being secured between the confined air and the incessantly changing aspects of the surrounding parts, great nicety was required in the trials; and when the balance was found it could only be prolonged by attentively noting the alterations and quickly and precisely suiting the pressure to the new feature. When desired, a reduction of the pressure could always be speedily effected, and required no special apparatus; but a rapid increase at some critical stage of the work could only be obtained by having at the disposal of the engineer machinery powerful enough to immediately supply his demands. This he has had, and we find among the permanent plant located near the mouth of the shaft air-compressors of large power and of the best patterns.

The tunnel has been prominently before the public for the past two years. Every step of its way has been described in a popular style by the daily press of this city; every new device in the appliances, or new method of accomplishing a certain object has been chronicled in the technical journals. The magnitude of the undertaking and the novel plan of construction have combined to render it a most pleasing and profitable study for the engineer, and as there is an inherent curiosity implanted in the majority of men, leading them to inquire as to the when, where and how a particularly difficult or dangerous work was done, and as these same men have a sort of undefined longing to enter the scientific world, or at least to gaze upon the borderlands, so this topic, whenever treated by the popular press, has found many interested readers. That portion of the commercial world which has at heart the advancement of the business of this port is quietly watching the progress of the work. The financial benefits to be derived from the completion of such a pathway under the Hudson are too manifold and apparent to need even an enumeration.

A glance at a railroad map of New York showing the termini of roads bringing the produce of the great West, and a brief calculation of the annual value of this traffic and the at present unavoidable delay occasioned by the river, explain the paramount importance of the work. What would follow a completion, as regards other tunnels, can only be conjectured, yet we have no hesitancy in predicting several.

It has been the endeavor of ENGINEERING NEWS to describe and illustrate the work at the time the special methods under consideration were in operation. We have attempted to do this in such a manner that the articles, taken as a whole, would constitute a history of the work compiled from actual observation. In this we have been favored by permission to visit the "heading" whenever it was deemed advisable, and have been most materially assisted by the explanations "on the spot" from the engineers and by the loan of plans to aid us in making drawings. Although we have visited the tunnel at all hours—seasonable and unseasonable—we have invariably been received with that kind courtesy and attention which a reporter above all men, is best able to appreciate. We this week present to our readers a double page lithograph of drawings and a description of the tunnel at

THE NEW YORK WORKS.

The caisson was sunk during the latter part of last year and the fore part of this to its position, shown at *K*, Fig. 1. It passed through a conglomerate filling, old dock work, which occasioned much delay, dock mud, and finally rested in a bed of sand interspersed with small rock and gravel. The lower portion of the caisson was 48 ft. long and 29 ft. 6 in. wide; its height was 25 ft., and the sides had a batter of one-half to one and were 3 ft. thick. The top was 46 ft. long and 27 ft. 6 in. wide. The sides were of unusual thicknesses of timber running in contrary directions and well fitted and securely bolted together. Vertical and horizontal struts of heavy timber were placed in the interior. A supply shaft and lock (shown at *F*, Fig. 1) came through the center of the roof. A man shaft was constructed at *G*, with a lock at the upper end, *F*. The ascent was made by two ladders, and its size and position were such as to form a safe refuge for the men in case of accident. A timber lock is placed at *H*. Extending through the center of the caisson and coffer-dam is a pipe, whose lower end turns, dipping into the water and is capped with a screen, and whose upper end is connected with a rotary pump. The discharge is into a box-sewer leading to the river. The pump is driven by an oscillating engine receiving steam from the regular boilers, which, together with the air-compressors, are in a building about one hundred feet from the shaft.

The fact that the caisson was imbedded in sand led to the belief among many engineers of high standing that an outlet could not be obtained and the tunnel started by the system of working by compressed air. Indeed, it has become unsafe to pronounce an unfavorable opinion in regard to any particular piece of work connected with the tunnel; in more than one instance, obstacles, which have seemed to present an insurmountable barrier to all future progress, have been met, conquered, and the work has gone forward. New devices and plans have kept pace with new difficulties. At a first glance, the sand above mentioned seemed to contain all the characteristics requisite for a first-class insurmountable obstacle. Upon the least reduction of the air pressure this material would follow the water into the caisson; the smallest openings afforded a ready passage. The water and sand could be kept quiet as far down as the air pressure was carried and no further, and if a trench were dug, or undertaken, the upward pressure, due to the difference between the air pressure and head of water, or depth of excavation, would fill the trench with sand and water about as fast as it could be taken out, and the adjacent material would then be in no better condition than at first.

Before any work had been done toward opening the heading, the following method was believed to be the best under the circumstances: A movable bulkhead or dam, made of oak plank, held at the ends by heading props and by braces from the side of the caisson, or face of completed work—as the case might be—extending from about 6 in. above the invert to the roof or crown plates. The opening at the bottom was left to permit the water to flow from the heading and be pumped away. It was expected that considerable would drain away, and that the condition would thereby be improved. Progress was to be made in this way: The air pressure being maintained at about 1½ pounds per square inch more than what would be necessary to keep out water at the crown, the upper plank would then be removed, enough material taken out to admit a plate, when the plank would be moved forward and supported against the next set of props. The next plank would be advanced in the same manner, and so on down to the bottom.

In actual practice iron was substituted for plank, and it is believed that no progress could have been made if this had not been done, from the mere fact that a bulkhead of iron could be made air-tight—a thing which was not possible with one of wood. The work of cutting through the caisson may be briefly described as follows: A score or mark had been made on the inside of the caisson of the exact form and size of the tunnel at the time of its construction, and no spikes were driven within 6 in. of this mark. After the invert had been finished, men were set at work boring with two and two and one-half inch augers on that mark, the air pressure being kept at about 18 pounds. As soon as the caulking course of 4-in. planking had been pierced, the air escaped in small quantities; but after the augers had reached the diagonal planking between the 12 by 12 timbers, the air rushed out with a loud noise. This was stopped by "blowing" dry cement into the holes whenever the leak was discovered. The blowing consisted in holding a lot of loose cement near the aperture, when the escaping air would carry it into the opening. Usually two or three quarts would suffice, but in the case of the first openings as many barrels were used. Wooden plugs were also provided and a number inserted in the holes after the removal of the augers, but the cement proved convenient, and was generally used. The boring was continued until nearly the entire circumference was penetrated, when the work of cutting out was begun. Owing to the number and arrangement of the spikes, dowels, tennents, etc., employed to fasten each piece of timber, this was a labor of great magnitude, yet patience and perseverance mastered the difficulties. As soon as a hole had been made, large enough to admit a plate, it was inserted, and held firmly in position by braces. To keep the exposed portion from flaking and falling before the plate could be placed in position, planks were held against it, as described further on. At a distance of 12 feet from the side of the caisson, a bulkhead of iron plates was started at the top, and built down. A system of struts, resting against the caisson, supported this bulkhead, which is put up in regular courses of 15 in. each, the plates being 4 ft. in length, except those for the ends of each course, which are cut to correspond with the section of tunnel at the respective courses. It was found impossible to advance a ring of plates of the usual width—2 ft. 6 in.—so they were changed to one-half this width, or 15 in. This was the first modification or change worthy of note from the practice on the New Jersey side, and although it necessitated more labor, it was advantageous in the increased number of angle-bars, in one direction, which nearly doubled the strength. The right thickness of plates is a subject open to much discussion (those used were one-quarter of an inch), and it was maintained by some connected with the work that it could be done without great or unusual risk with plates of any thickness, and that those in use were sufficient, and, being light and easily handled, it was expected by the exercise of skill and judgment in the bracing to hold them in place. It was also found expedient to further reduce the size of some of the pletes by cutting the half sizes in two; and finally a few were made only one-eighth the regular size in order to make a closure in unusually difficult ground.

The method of building the tunnel may be briefly summed up as follows: Making a small excavation and at once setting up an air-tight casing. Each horizontal course is completed before its successor is commenced. This forms what might be termed the segment of the upper part of a cylinder, which is gradully increased until there is a completed circle of plates open to the finished work at o ne end and closed by an iron wall at the other

The operation of advancing the iron plates to form the shell was an easy matter, so far as the roof plates were concerned—about one-fourth of the circumference—although great care and skill were required. Tha plan was to drive light "poling" strips of one-half by two inches, and about two feet long, directly in front of the last plate put in; the rear ends of the strips were pushed up above and then pulled back so as to rest on the plate already in place. This prevented the material from falling while the excavation was being made. The plate was put in, bolted to the one already in position, and a short brace put up, temporarily, to prevent settling; but it was found that the material on which the lower end of the brace rested was insecure, and systems of *A* braces, diagonals, verticals with mud sills, etc., were tried, but failed. When the heading had been extended about 12 ft., and the bulkhead put in, reaching across the face of the heading from side to side and down about 6 ft., it was found that the continued settlement of the roof had reached a point where some radical change in the plan must be adopted or the work would be stopped. The method adopted and which proved eminently successful is shown in Fig. 3. A piece of timber 12 in. square and about 10 ft. in length was so placed that one end rested against the outside of the caisson and the other extended into the face of the heading. The forward end was supported from the inside of the caisson by two iron tie-rods, one and one-half inch in diameter, and provided with turn-buckles, thus forming a kind of boom which was expected would sustain a load of from 50 to 75 tons. An upper member was added to this and with a strut or two formed a sort of truss, closely resembling a bridge truss. This arrangement constituted, probably, the principal aid in completing the first section.

The system of bracing shown in Fig. 2 was unsatisfactory for many reasons and was, therefore, supplemented by a better. The drawing shows a transverse and longitudinal section; in the latter the plates have been carried down not quite half way. We produce the drawing to illustrate one of the plans which was tried and found wanting.

The method of building the tunnel as now pursued is clearly shown in the transverse and longitudinal sections, Figs. 4, 5 and 6. Fig. 4 shows the bracing used for about the first quarter of the work; the vertical struts resting upon plates in the sand. In Fig. 5 the excavation has been carried down about half way and in Fig. 6 the iron shell has been completed and is ready for the masonry. It will be noticed that as the work proceeds the upper course of the bulkhead of the preceding section is removed and forms the lower in the new bulkhead.

After one section had been encased and was ready for the masonry, a quantity of fine sand came in through the joints of the bulkhead, and could neither be bailed nor pumped out. In consequence of this it was impossible to lay brick, and several hours were lost in dealing with it; but after repeated trials without success, and when a concrete invert seemed the only solution, an experimental brick weil, 8 in. thick and about 1 ft. high, was built entirely across the forward end of the section. This stopped the flow, and the invert was laid without further annoyance.

At a distance of about 80 ft. from the river side of the caisson an air-lock had been put in (*F*, Fig. 1). This lock is 15 ft. long, 6 ft. in diameter, and rests on a bulkhead of concrete, *I*, 6 ft. thick. From the bulkhead to the roof, and surrounding the lock, is a wall of brick masonry 3 ft. thick. At the time of the blow-out last week the masonry had been about one-half completed in the section which is shown about one-quarter excavated (Fig. 1).

Some two months since, a fire was discovered in the caisson near the roof; wet silt was forced into the opening burned through the 4-in. caulking course. This hola was about 4 in. in diameter; the wet silt soon stopped the fire at that point, but in a short time it was noticed that the caisson was getting very hot to the touch over an area of about 3 ft., and serious consequences were threatened. One end of a piece of one and one half inch pipe, about 4 ft. long, was inserted in the hole and the other placed in a bucket kept full of water. The water was carried into the burning wood-work and the fire quickly extinguished.

A NEW SAND-PUMP.

The pump illustrated in Fig. 7, which is a vertical section, was designed by Mr. C. W. Clift, the master machinist of the tunnel. It works upon the principle of the induced current. The water from a pressure-pump enters at *C*, and flows into a globular chamber, through the bottom of which passes the suction-pipe *A*, and passes out at *B*. Tha distance between the top of tha suction-pipe and the points *E* and *D* can be regulated by the screw, as shown, and any rate of discharge from *B* can be obtained with little or no trouble. The wear of the pump comes at *E*, where the sharp sand strikes against the sides. This is made of chilled cast iron, and the adjoining piece *F* of composition. These pieces are cast to fit the pump and require no adjustment, being held in position by the screw cap *B*, as shown. The body of the pump is of cast iron. In actual practice at the tunnel, the pump has been found to give the most satisfactory results—being economical, powerful, impossibla to clog, and of easy adjustment and repair—the mere turning of a screw accomplishing both.

Tha Hudson Tunnel Railway Company was incorporated for the purpose of joining the shores of New Jersey and New York by means of a tunnel under the Hudson River. The Hudson Tunnel Construction Company is now doing the work in the tunnel. The President of this company is Trenor W. Park, of Bennington, Vt.; Mr. D. C. Haskin is Manager, and is the most prominent man in connection with the enterprise. In the engineering department, S. H. Finch, C. E., is engineer-in-charge; E. H. Burlingame, C. E., makes a specialty of the alignment and grades of the tunnel; C. W. Raymond, Mem. A. S. C. E. and J. W. Wolbrect are assistant engineers on construction; C. W. Clift is mechanical engineer in charge of machinery; M. Nolan, formerly of the Dorchester Bay Tunnel, for the Boston improved sewerage, is superintendent, in place of C. C. Lovejoy, now with the N. Y., O. & W. R. R., as superintendent of bridges and buildings; George F. Seward, ex-Minister to China, is connected with the financial department at the works. A large Clayton air-compressor will replace the present small one on Oct. 1. The air is now being supplied by two of the Ingersoll Rock-Drill compressors. A small Andrews' pump keeps the water in check.

There was a "blow-out" at the tunnel on the 30th ult., which happily caused no loss of life, but which has delayed work somewhat. On Wednesday of this week the removal of a small boulder was the cause of a loosening of the material in the roof of the tunnel, so that the men were driven out of the heading; but the leak was stopped and the men returned to work within half an hour. On the same day an inroad of the silt drove the workmen out of the Jersey end of the tunnel, but at our visit on Thursday we were informed that the leak had been stopped and work was progressing as usual. The engineers explain the trouble as follows: The silt is held in its position best when at a certain point of saturation; if the air pressure is increased it drives the water into the silt, which becomes flaky and liable to disintregate; the difference of one pound of air pressure will cause this change, and from this cause it was that the silt got started on Wednesday, and before it could be "plugged" it filled the heading. The manager and engineers do not seem to fear these mishaps, except that they add to the labor and expense of the work and also cause delay.

CORRESPONDENCE.

ALGEBRAIC PROBLEM.

LOUISVILLE, Ky., Aug. 22, 1882.

EDITOR ENGINEERING NEWS:

The following seems to me to be the easiest way to solve the algebraic problem in the last NEWS:

(1) $x^2 + y = 11$

(2) $y^2 - x = 1$

From (1) $x = \sqrt{11 - y}$

Sub. in (2) $y^2 - 1 = \sqrt{11 - y}$

Squaring $y^4 - 2y^2 + 1 = 11 - y$ or $y^4 - 2y^2 + y - 10 = 0$.

THE ROOT OF *y* MUST BE A FACTOR OF 10 or 1, 2, 5, or 10.

Substituting 1 for y in (1) and (2), we get diff. vals. for x.

∴ this is not the root sought.

Subs. 2 for y and we get the same val. for x in both equations.

$\therefore x = 3$
$y = 2$

Respectfully, ED. H. BOWSER.

We have received solutions with the results from Assistant Engineer Wabash, St. Louis & Pacific Railway, Peoria, and from S. C. W., Chicago, Ill., who makes $x = 3$; $y = 2$;
$x = -3.6264$; $y = -2.1509$.

ANSWER TO PROBLEM.

CHICAGO, Aug. 28, 1882.

EDITOR ENGINEERING NEWS:

In answer to Henry Thompson's problem, page 289, ante, I believe there is no solution, owing to the fact that if we suppose the triangle required, be constructed, and the data given be noted, an examination will show that there is not data sufficient to perform eny sort of a calculation. However, if it will answer the purpose, the following is the result of a graphical operation which will give him the triangle sought, with an error of less than one inch in this case. The value of such an error will be great or small, according to the purpose for which the solution is wanted. The sides of the triangle will be, $AE = 45' - 0\tfrac{1}{8}''$, $AD = 45' - 0\tfrac{1}{8}''$, and $DE = 44' - 11\tfrac{5}{8}''$, an error of three-quarters of an inch.

CHAS. J. BATES.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 304.)

CCCLXXV.—HARRISBURG, PA.

Harrisburg, Pennsylvania, in lat. 40° 15′ 44″ N., long. 76° 52′ 56″ W., on the Susquehanna River, is chiefly on a plateau from 26 to 50 ft. above the river and extending back on the hills.

It was settled in 1726, and incorporated as a borough in 1791 and as a city in 1860. Water-works were built by the borough in 1844 after plans of F. Erdman, C. E., taking the supply from the river through a 30-in. cast-iron pipe, laid 108 ft. into the river, and pumping it by a horizontal high pressure, crank and fly-wheel steam engine of 12-in. cylinder, with pump of 8-in. bore, both of 60-in. stroke, into a reservoir built in excavation and embankment 150 ft. square and 16 ft. deep, with its water surface 91.32 ft. above low water in the river and 2,046 ft. from the pump. The force main was an 8-in. cast-iron pipe. In 1860 a Worthington duplex pump, with 18-in. steam and 15-in. water cylinder, of 36-in. stroke, was added, and a 16-in. force main laid.

In 1867-9 the daily consumption was 1,099,089 gallons and the works had cost $235,000. In 1874 new works were built after plans of H. P. M. Birkinbine, C. E.

Two horizontal crank and fly-wheel engines, one non-condensing, with 30-in. cylinder, the other condensing, with 54-in. cylinder, both having 22½-in. pumps with 60-in. stroke, and arranged to work either separately or as a compound engine, lift the water 231 ft. through a 30-in. force main into a stand-pipe 5 ft. in diameter and 205 ft. high, inclosed in an ornamental brick tower, and into a reservoir 200 by 300 ft., built in excavation and embankment, 230 ft. above the pumps, and containing 20,000,000 gallons in two basins. There is also a Knowles' pump, of 20-in. steam and 14-in. water cylinder, with 24-in. stroke.

Distribution is by cast-iron pipe, of 20 to 4 in. diameter, of which 21 miles are laid, with 250 fire hydrants and 8,000 taps. Wrought-iron service pipes are used.

The population in 1880 was 30,762, and the daily consumption in 1881 was 4,750,000 gallons.

The works have cost $600,000, and the bonded debt is $551,000, at 6 per cent. interest. The expenses in 1881 were $16,723 for maintenance, and $33,066 for interest. The receipts were $50,000.

The works are managed by a committee of the City Council. J. H. Weitmyer is the Superintendent and Engineer.

CCCLXXVI.—CATASAUQUA.

Catasauqua, Pennsylvania, in lat. 40° 39' N., long. 75° 25' W., on the Lehigh River, is in a hilly country. It was settled in 1840.

Water-works were built in 1842 by the Crane Iron Company, taking the supply from the Lehigh River through a feeder of the Lehigh Canal, a mile long. Two pumps of 6-in. bore and 48-in. stroke, driven by water-power, lift the water 125 ft. into a reservoir of cemented masonry, 60 ft. square and 12 ft. deep, and a stand-pipe 127 ft. high and 5 ft. diameter at base.

Distribution is by cast-iron pipes. Those first laid were of 4 and 6 in. diameter, since changed to 8, 10 and 12-in. There are 34 fire hydrants and 400 taps. The town pays $12.50 per annum for each fire hydrant. Lead service pipes are used. The population in 1880 was 3,856. The daily consumption is not given. The works have cost $50,000. No further financial statements are given.

Joseph Hunt is the Superintendent.

CCCLXXVII.—NATICK.

Natick, Massachusetts, in lat. 42° 16' N., long. 71° 20' W., is on the Charles River.

It was incorporated as a town in 1781.

Water-works were built by the town in 1874, after plans of M. M. Tidd, C. E., taking the supply from Dug Pond, a natural lake of 26 acres area, and about one square mile water-shed.

The water is pumped by a Worthington duplex engine through 12,000 ft. of 12-in. pipe, to a reservoir built in excavation and embankment, containing 3,500,000 gallons, 175 ft. above the pump.

Distribution is by 22 miles of wrought-iron and cement pipes of from 12 to 4-in. diameter, with 122 fire hydrants, 134 gates, 837 taps and 19 meters.

Galvanized iron and cement lined wrought-iron service pipes are used.

The population in 1880 was 8,000, and the daily consumption in 1881 was 213,000 gallons.

The works cost $200,000. The bonded debt is $171,000, at 5, 6 and 7 per cent. interest. The receipts have been $56,808.05.

In 1881 the expenses were $3,925.11, and the receipts $11,298.72.

The works are managed by a board of three commissioners.

J. W. Morse is the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is acknowledged with thanks: From R. A. Bryan, City Engineer, statistics and reports of the water-works of Portsmouth, Ohio; from Isaac W. Crane, Superintendent, statistics and water rates of Hackettstown, N. J.; from J. J. Sager, reports, statistics and water rates of the water-works of Trenton, N. J.; from D. P. Bruner, C. E., reports, statistics and water rates of the water-works of Harrisburg, Pa.; from Joseph Hunt, Superintendent, statistics and water rates of the water-works of Catasauqua, Pa.; from J. W. Morse, Superintendent, statistics of the water-works of Natick, Mass.

AN ART AND INDUSTRIAL EXHIBITION IN THE CAPITOL AT WASHINGTON.

UNDER THE AUSPICES OF THE SOCIETY OF THE ARMY OF THE CUMBERLAND, FOR THE BENEFIT OF THE GARFIELD MONUMENT FUND.

The Board of Direction, composed of some of the most prominent names in public life, including members of the Supreme Court, Senators, Members of Congress, Army and Navy officers of high rank, and the first citizens of Washington, send the following to the press:

A National Bazaar, Art and Industrial Exposition will be held in the rotunda and adjacent halls of the National Capitol at Washington, D. C., November 25 to December 3 (inclusive), 1882, as authorized by joint resolution of the Senate and House of Representatives, August 7, 1882. The object of this undertaking is to raise funds with which to erect a statue in this city to the memory of General James A. Garfield, late President of the United States, which work is in the hands of a committee of the Society of the Army of the Cumberland, who have already collected for this purpose some twenty thousand dollars, and expect, with the results of the exposition, to have a sufficient sum with which to erect a work befitting the great name it is proposed to commemorate.

The art exhibition will be under the direction of the leading artists resident in Washington. It is hoped that artists throughout the entire country, professional and amateurs, will aid the work by contributing some one work—as a gift to the fund—to be sold for its benefit, and be willing to exhibit others, under such rules and regulations as may be determined by the Board of Direction. All persons desiring to contribute in any way to this great work are cordially invited to do so, and to proceed in such manner as their judgment may dictate.

Contributions from the ladies in the way of needle and fancy work are especially invited and anticipated as one of the more prominent features of the exposition.

To manufacturers this exhibition offers opportunities second only to the Centennial Exposition. Occurring on the eve of the assembling of Congress, and at the season of the year when all the foreign representatives are at their legations, every exhibit will have the attention, not only of our own representatives, but of the representatives of all the civilized nations, as well as the representatives of the press, who will gladly make full mention of all worthy exhibits; this, with the fact that each donation or exhibit contributes so much to a work that must commend itself to every patriotic citizen. All exhibits will bear the name of artist, manufacturer, etc., and will remain in place until the close of the exposition. Arrangements for transportation of exhibits are being made, and details will be given on application to the Board of Direction, rooms 90 to 96, Ebbitt House, Washington, D. C.

NARROW-GAUGE RAILWAYS.

Ten miles below Woodbridge, on the Moquelumne river, in the county of San Joaquin, is a new shipping port called Brackville. It is the tide-water terminus of a narrow-gauge railway now in course of construction, thirty-five miles being completed and in operation, carrying freight and passengers through the best settled and best cultivated part of the Moquelumne valley—that on which the celebrated Moquelumnes grant was located, known in Stockton as "the Live Oaks." The eastern end of the road is already a little east of the town of Lockford, over-looking one of the richest low-lying bottoms in the country, and not far from the foothills of Calaveras county. The present freighting capacity of the road is taxed to its utmost, and the company are procuring new rolling-stock to accommodate the incoming wheat and barley harvest, always good in that region. It is not the intention to stop the road in the valley, but to build on through the Calaveras foothills, and far into the lumber region at and above the original Big Tree grove, where there are hundreds of square miles of the best sugar-pines in the Sierra Nevada, as yet but little disturbed by the local millmen. The lumbering capacity of this sugar-pine country will supply as much freight as the road can carry for half a century to come, and it is exactly the kind of freight which is needed for the improvement of the valley lands and the trade of this city. Sugar-pine is the most costly of all lumber. It is used for fine cabinet ware, panel doors, window frames, and the flooring and wainscoting of elegant houses. The demand for it is unlimited; but the supply cannot be advantageously tapped without railway communication with the Sierras, at least as far up as an altitude of 5,000 ft. above sea level. Broad-gauge railways are too expensive for this purpose. Neither are they well adapted to the high grades and sharp curvatures that must needs be encountered in the mountains. The narrow-gauge meets these desiderata. A road of that kind can be constructed, equipped and operated for less than half the cost of the ordinary broad-gauge road. This San Joaquin narrow-gauge road is owned and managed by local capitalists of Sacramento and San Joaquin counties. Some of them are merchants, others wealthy farmers, and nearly all of them have interests to be developed by the transportation it will afford for their produce. We understand that they will be able, without borrowing or mortgaging the road, to build as far as the Big Trees at least. If they go no farther eastward, the timber tapped there will supply freight enough to pay expenses and fair dividends. But there is some hope that in the near future this road will connect with a narrow-gauge system in contemplation for Nevada, to tap the Bodie mines, and connect with the Eastern system of railroads.

Another narrow-gauge railway enterprise is taking shape for the connection of Oroville, Marysville and Chico with the high timber lands of Plumas and Lassen counties, and with an outlook toward the extensive grazing and dairy farms east of the Sierra, in the direction of Goose Lake and Southern Oregon. Nicholas Luning, a stout and keen-witted capitalist of this city, stands at the head of it, and will be able to command all the money needed to put it through.

Neither of these roads will cost more than $8,000 to $9,000 a mile in the valley, nor over $12,000 to $15,000 in the mountains, save where tunneling or high bridging or deep cutting is required. Broad-gauge roads cannot successfully compete with them, as is proved by the operations of the Santa Cruz narrow-gauge against the monopoly's broad-gauge, which taps a part of the same region that feeds the narrow-gauge. The running expenses are less by 40 per cent. than on the narrow-gauge. It carries less dead weight in cars and engines by 60 per cent, and the wear and tear of material is but trifling by comparison with that of the broad-gauge.

It is probable that if relief ever comes to the people of California from the oppressions and insolence of the transportation monopoly, it will come through the medium of narrow-gauge railways, constructed and operated on a cash capital supplied by the local merchants, farmers and lumbermen directly interested in the construction of short lines for the development of their other business. The farmers and merchants of San Joaquin valley, for an illustration, could build and equip a narrow-gauge railway for what their overcharges by the monopoly will amount to in five years. The surplus of a single good crop of wheat and barley would suffice to carry the enterprise through.—*San Francisco Chronicle*, Aug. 16.

REPAVING OF SIDEWALK ON PENNSYLVANIA AVENUE, WASHINGTON.

The work to be done under the contract to be given out by the District Commissioners for laying the sidewalks on the north side of Pennsylvania avenue, between First and Fifteenth streets northwest, amounts to 10,000 square yards. The District authorities will cause the old material to be removed, consisting of bricks and stone flagging, which form the present sidewalk, but all subsequent work will be done by the contractor. To obviate the necessity of removing or opening the new sidewalk at any future time for the purpose of laying or repairing gas and water pipes, etc., pipe connections will be laid from curb to building line at such points as may be ordered. These will consist of 6-in. terra cotta pipe, the joints pointed inside and outside with mortar of hydraulic cement as pipes are laid. These pipes will be 2 ft. below the surface and on the same inclination with the sidewalks. Each pipe will terminate at the curb by a cemented joint in a brick box, built of old paving bricks laid in the same kind of mortar. The box will be 2 ft. square, in horizontal sections, and 3 ft. deep, and will be covered by a slab of the sidewalk 2 ft. 8 in. square; and provided with rings and staples to lift it.

Various sizes of sidewalk will be admitted to competition, as follows:—1. Foundation of concrete of hydraulic cement, four inches in depth; wearing surface of asphaltic cement concrete one and one-half inches in depth. 2. Foundation of concrete of Portland cement 3 inches in thickness, wearing surface 1 inch thick, composed of mastic made from the natural bituminous limestone of Seyssel, or *Val de Travers*, in such manner as may be proposed by bidders. 3. Foundation, two inches in average thickness, composed of mortar of hydraulic cement equal to Shepherdstown, as manufactured for the engineer department of the District; wearing surface, bluestone flagging, three inches in average thickness, in pieces not less than four by six feet, nor more than six by eight feet, etc. No bids will be entertained unless accompanied by the samples above mentioned, duly labeled with the bidder's name.

This work is to be first-class throughout, meeting fully the requirements as set forth in the specifications, and the approval of the District engineer officers, who will give its progress their special attention.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, SEPTEMBER 2, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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SOCIETY MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS 127 EAST TWENTY-THIRD STREET, NEW YORK.—A meeting of the Society will be held on Wednesday, Sept. 6 1882, at 8 o'clock p. m. Ballots for membership will be canvassed, and business transacted. A paper by Wm. Bell Dawson, Associate Member Institute Civil Engineers, on *Rapid Methods in Topographical Surveying*, will be read. Mr. J. B. Brown, C. E., will exhibit the working of the Fleuss Diving and Noxious Gas Apparatus, and the Safety Lamp.

Aug. 31, 1882. JOHN BOGART, Secretary.

The Library and Conversation Rooms are open each Wednesday evening from 7:30 to 10 o'clock.

THE VERY VALUABLE paper on House Drainage and Sanitary Plumbing by Wm. Paul Gerhard, Civil and Sanitary Engineer, of Newport, R. I., is reprinted in the *Sanitarian* for September. The only method now of obtaining this paper is by buying a copy from the *Sanitarian*, for which send 30 cents to 113 Fulton st., New York City. Mr. Gerhard notified us some weeks ago that neither he nor the State authorities had any copies to spare.

THE attention of contractors is especially directed to the large number of government and other proposals for contracts advertised in this week's ENGINEERING NEWS. We do not know of any newspaper in this country that can present to this class of readers such strong claims for their patronage as can this journal, which is already throughout the whole Union accepted as *the* contract journal, par excellence. The past eight months have been the most prosperous ones we have ever known; our subscription list has increased in numbers very satisfactorily, and our advertising patronage tells its own story. We intend to make ENGINEERING NEWS even more thoroughly than it now is—a business man's paper, where, in condensed form he may scan each week the record of the principal construction work of the entire country.

THE cheap edition of "Greene's Bridge Trusses" is *sold* out, and not another copy can be had. We will return all further orders sent us for the book. The best bargain we have to offer now is Merriman's "Introduction to Geodesy," price $1.50, but which we offer to close out our stock on hand as follows: *One Geodesy*, together with *any one* of "Van Nostrand's Science" series, for *one dollar*, in currency or postage-stamps. No need to register or to buy a postal-order if proper care in addressing is observed. Anything from the pen of Prof. Merriman is worth reading, and for surveyors or others interested in geodetics, this little treatise cannot fail to be of service. Quite a number of copies have already been sold since its publication last fall, and we only offer it at a reduction now because *our habit* is to have things "move lively." When we cannot sell quickly we *give away*. We now practically offer this book at 50 cents a copy.

AMERICAN INSTITUTE.

The 51st industrial exposition of the above institute will commence September 27th. Space is being applied for with unusual rapidity. In addition to the usual display of American manufactures, there will be a number of mechanical inventions in operation. The building will be lighted by the electric lights, and Arbuckle will be on hand with his silver horn. The coming exhibit is being skillfully arranged. Chas. Wager Hall, the faithful Superintendent, John W. Chambers, the attentive Secretary, are at their post, where their long experience has made them very efficient.

OUR BOOK TRADE.

Our book trade has quadrupled in amount the business of last year. It is almost exclusively a mail trade. We fill orders daily from Maine to Mexico, and from Key West to Alaska. We guarantee safe delivery of all our orders; a complaint from a patron is a rare occurrence, and is always promptly investigated and adjusted to his satisfaction. We try to do the best we can, and so get the benefit of our patrons' good-will. It pays us, and stimulates to still better things. We publish this week a list of books which we think will recommend itself as containing the best and latest on the subjects enumerated. We invite orders for these and any other books in the market. Anything in this market which we can buy for our subscribers may be ordered through us, with the assurance of being obtained at lowest prices, and promptly forwarded to any address.

LEVEE CONSTRUCTION.

There is now a large amount of levee construction being done along the Mississippi and Illinois Rivers, and there will, undoubtedly, be a large increase in the amount; engineers and contractors are interested, and would like to get an intelligent idea of what is being done. ENGINEERING NEWS will be pleased to hear from the engineers engaged on such work, and such communications may lead to a discussion of this important, but little understood, subject that may be of very great advantage to the public. ENGINEERING NEWS unhesitatingly claims to be the especial organ of American engineers and contractors, and in no way can these classes be reached so readily as through its columns. There has, practically, been nothing published on the construction of levees, and never was there a more appropriate time than the present to bring the subject up for discussion. Let us hear from some of the levee engineers.

ENGINEERS AND ENGINEERING IN OTHER LANDS.

[Specially translated and prepared from our exchanges.]

The improvement of many European harbors has now, in view of the great size of modern steamers, become a necessity, and promises to give rise to larger votes than the recent congressional measure. The French engineers have been discussing the project of M. Bert for the construction of a road or harbor where the vessels might find shelter before entering the maritime Seine. The harbor would be completed by a hanging platform of 600 meters in length and capable of receiving twelve transatlantic vessels at the same time. This platform would be joined to the shore by a jetty some 700 meters in length, and running from deep water to the borders of the sea. Of course, the jetty would be sloped off so as to give vent to the current. On leaving the jetty the trains would pass beneath Havre and have their exit in the plain of the Eure. The dike protecting the road would be in two divisions—one on the side of Cape Hague and another between the central and south passes. The width of the the road would be 2,200 meters, its length 4,500, thus covering some 3,300 acres. The reasons for this roadstead are the following: The strong northwest winds coming in between the two jetties make heavy seas and shoals. M. Bert proposes to suppress the waves in the outer port, so that vessels can meet with a relatively calm sea before entering Havre. The estimated cubic measure of the dike is 2,000,000 meters at an average of 11 francs. The entire cost, with the viaduct, etc., cannot be less than fifty millions. The principal objection urged against the project by engineers is the silting up; but they give, says M. Bert, no arguments. They say that sand banks are formed in calm seas, but in the roadstead of Havre there is calm without rest; that is, the unleveling process of the tides which rise and fall 24 ft. in 24 hours, will effectually prevent the formation of any sand banks. In the maritime part of the estuary in Havre a dredged part never rises again; but it is different in the Seine, where millions of cubic meters may be dredged only to be filled up again next day. There are no alluvial deposits, however, in Havre. One engineer cited in opposition to this view the experience at Cherbourg where blocks of stone of 10 cubic meters used in the dikes were knocked about and carried over the stone packing into the middle of the roadstead, and he could not understand how an enrockment made up of loose stone curbing only 1½ meters thick would not be shifted at the first gale. Some other objections were made, but one point which would seem to be of importance was touched upon—the increased volume of water-tide ascending and descending would form, as it were, a very powerful dredge in itself and would tend to materially deepen the beds and keep them clean.

This question of deepening and protecting harbors is the order of the day, and we purpose to give, in an early issue, descriptions and illustrations of the new harbor works at Libau, Riga, Reval, St. Petersburg and Cronstadt, showing also the system of seawalls and breakwaters adopted.

This very advance in engineering science has again evoked the idea and the hope, so dear to "Boulevardiers," of seeing Paris—a port. The puffy little boats that go under the bridges on the Seine are not commensurate with present ideas—pseudo-maritimes. It is an old question, and the French engineers of to-day commence their *étude* with a history of old forgotten projects. Now, nothing is more ominous than to see practical engineers going back to antiquity. It reads well, but recently, *à propos* of the cutting of the isthmus of Corinth, we were treated to the engineering designs of that amiable individual—the Emperor Nero

The Société d' Industrie Minérale recently appointed a dynamite committee (no connection with the Hiberno-American) to adopt rules for the treatment and storage of that formidable explosive. The result of its investigations show that accidents from dynamite are less numerous than from any other explosive—but more serious; but, the quantity of dynamite kept at any one place in stock is generally very small, so that dynamite is, under every circumstance, to be preferred. English and Belgian committees have been investigating the matter also, and this society coincides in their views. Dynamite is divided into three catagories, from one hundred weight to less than 15 pounds. The first category is divided into eleven classes, according to quantity and distance.

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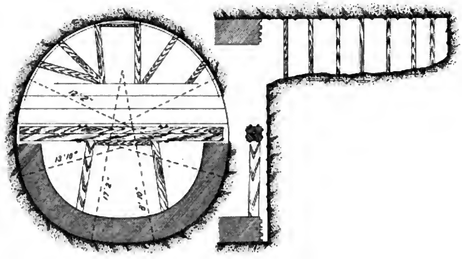
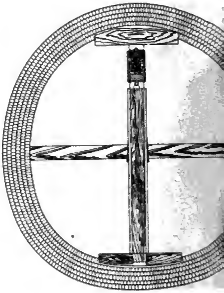
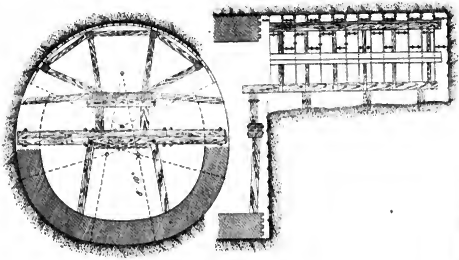


Fig. 4.





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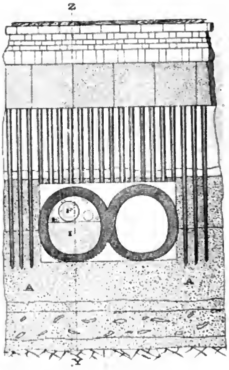


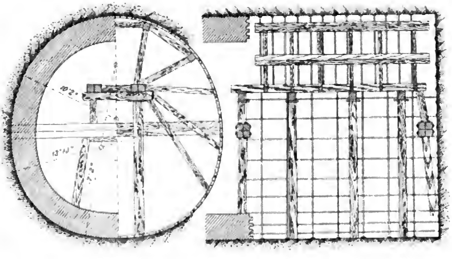
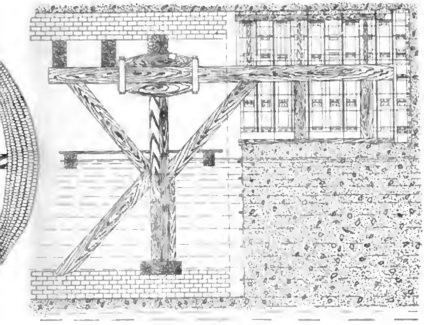


Fig. 6.

ON RIVER TUNNEL.
EW YORK WORKS.



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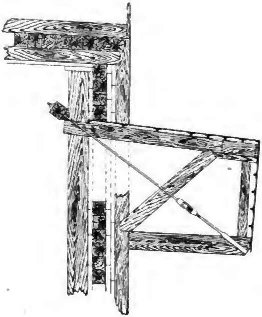

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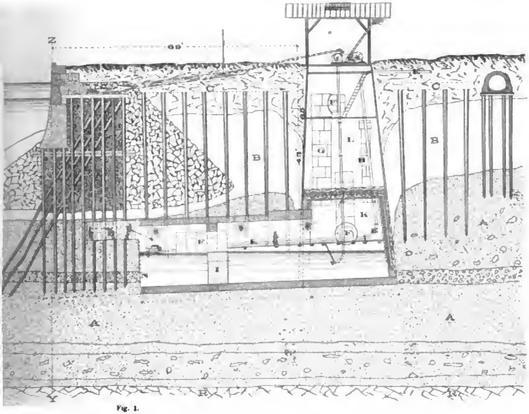


Fig. 1.

Explanation of Letters in Fig. 1.

AA—SAND.
BB—DOCK MUD.
CC—FILLING.
EE—AIR PIPE.
FF—AIR LOCKS.
G—MAN SHAFT.
H—TIMBER LOCK.
II—CONCRETE BULKHEAD FOR AIR LOCK.
K—CAISSON.
L—COFFER DAM.
N—IRON BULKHEAD.
RR—BED ROCK.

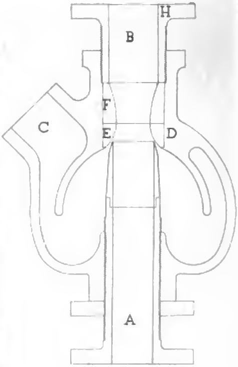


Fig. 7.

Explanation of Letters in Fig. 7.

A—SUCTION.
B—DISCHARGE.
C—WATER FROM PRESSURE PUMP.
D—CAST IRON.
E—CHILLED CAST IRON.
F & H—COMPOSITION.

Another great project in the way of canals, now a French specialty, is the North Canal, and the Paris Municipal Council have authorized a complete survey to be made, at the same time expressing a wish to have the canal extended as far as Dunkirk, which is, in fact, one of the principal ports of France, the headquarters of the Icelandic and Newfoundland cod-fishing trade, and with a population for more Flemish and "low" Dutch than French. It is very likely that English capital will be largely invested in this enterprise, as it would greatly enlarge the market for English coal. The total length would be 235 kilometers, but of this 49 kilometers of existing navigable ways would be utilized. The cost is estimated at 105 million francs. The committee require now a bottom width of 17 meters, and a depth of about 6 ft. 7 in. The saving in distance between Paris and Dunkirk would be some 110 kilometers, while the navigable ways to the Mediterranean would be only 1,145 kilometers.

The foreign iron markets, especially in Germany and France, seem to be firm, and, doubtless, when the Egyptian war is over there will be a great revival in new enterprises of a solid character—engineering works coming foremost.

The project of an interior sea in Africa has been *completely* condemned by the French Scientific Committee. There were three sub-committees, however, but the question of evaporation and those other two important queries, how much will it cost, and, *cui bono?* induced the committee to give an adverse opinion.

In addition to the Russian system of seawalls, we intend to give in a few weeks an account of improvements in surveying instruments, etc.

PERSONAL.

ASSISTANT ENGINEER CLARENCE A. CARR, U. S. N., has been ordered to special duty as instructor at the Stevens Institute of Technology, Hoboken, N. J.

MR. EDW. BARRINGTON, late Assistant Engineer on the Northern Pacific Railroad, and recently Locating Engineer on the Texas Mexican Railroad, has been appointed Resident Engineer of the G. H. & H. R'y, with headquarters at Galveston.

J. D. **ESTABROOK** has been appointed by Chief Engineer Smedley, of Philadelphia, to the office formerly held by R. **HERING**, who resigned eight months ago. Mr. **ESTABROOK** is a very competent engineer, and is well known in Philadelphia, where he was formerly engaged on the park improvements. He has recently been in the service of the Northern Pacific Railroad, with headquarters at St. Paul.

LIEUT. WILLARD YOUNG, a son of **BRIGHAM YOUNG**, is a teacher of engineering at West Point. A Salt Lake correspondent says: "He was at West Point when his father's estate was being settled up, and when the litigation began his agents wrote to him to know what they should do. He replied that he didn't care about quarreling over the matter; that he had a profession that would give him a living, and that he would take what the others didn't want. So a lot of railroad stock, supposed to be nearly worthless, was assigned to him. He took it, and the development of the territory has since made him one of the richest of the old man's heirs." He is now in Utah on his wedding trip.

Yesterday the places in the Board of Directors of the Akron Sewer Pipe Co., vacated by the withdrawal of Mr. **DAVID L. KING**, so many years Secretary and Treasurer of the company, and his son, **HOWELL S. KING**, were filled by the election of Mr. **DAVID E. HILL**, the veteran manufacturer, and Mr. **FRANK W. ROCKWELL**, member of the Board of Education for the Sixth Ward and for a dozen years past the company's bookkeeper. Mr. **ROCKWELL** was also chosen to succeed Mr. **KING** as Secretary and Treasurer, a position for which his long service in the company's office peculiarly qualifies him. The promotion is well earned and well deserved, and his friends will heartily congratulate Mr. **ROCKWELL**. Mr. **FRANK ADAMS**, who has been in the business for 28 years, is still President of the company, and in immediate charge of its manufacturing interests as heretofore. Since the establishment of this important enterprise, in 1848, this pioneer manufactory of glazed sewer pipe has never been in better condition in every respect than at present, and improvements are in contemplation, of which it would be premature to speak at present, that will make the Akron Sewer Pipe Works even more truly than ever the largest devoted to this exclusive branch of manufacture.—*Akron Beacon*, Aug. 17.

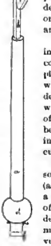
F. W. **ROCKWELL** having been duly elected Secretary and Treasurer of "Akron Sewer Pipe Co.," vice D. L. **KING**, resigned, all communications, remittances, etc., should be addressed either to Akron Sewer Pipe Co. or F. W. **ROCKWELL**, Secretary, and all checks, notes or drafts should be made payable to Akron Sewer Pipe Co., or F. W. **ROCKWELL**, Secretary. **FRANK ADAMS**, President.

THE inventor of the surveyor's chain, **EDMUND GUNTER**, a contemporary of **SHAKESPEARE**, died six years after Plymouth was settled by the Pilgrims. His inventions might be regarded by some as providential of the measuring of a new world, especially as he was a clergyman, like the inventor of gunpowder. With the chain, 66 ft. long, and its links and rings, a boor could measure an acre of ground. **GUNTER** also invented the line, to solve problems instrumentally, the *quadrant* to take altitudes, and the *scale* to solve problems in trignometry. He belongs to that great galaxy of men whose monuments are the tilled fields and the standing crops of the world. Not far from his abode is the original home of the first settlers at Plymouth Rock, at an uninteresting little town called Scrooby.—*Gath*.

DEEP-SEA SOUNDING APPARATUS.

It seems that soundings obtained by apparatus attached to lines are, below a depth of 2,000 fathoms—or say, two miles—generally unreliable. Again, line soundings of four or five miles require an enormous quantity of line strong enough to support a very heavy sinker and expensive special preparations, and are attended with frequent loss of lines.

To a man who can't swim, six feet is as bad as six miles; and if more than six feet, the majority don't care to know any more about it. But scientific folks do. They can't be perfectly happy till they have fathomed deepest depths and learned what is going on down there, and how the inhabitants amuse themselves.



Apparatus to be used without a sounding-line has already been invented. It consists of a buoy and a self-acting plummet or sinker. Cast upon the waters it goes to the bottom, the sinker detaches, the buoy rises again. In some way the depth is determined by the time of absence of the apparatus (it having been previously timed in known depths), in other cases by registering apparatus, current-meters, etc.

It would seem that more accurate soundings might be obtained by a *diver* (as we will call an apparatus without a line) than by a line. The lateral drift of a diver does not affect the time of its descent or return; but with a line two miles may be reeled out, while the vertical distance is but one and a half miles or less. Although Capt. Denham, of H. M. S. Herald, obtained the remarkable sounding of 7,700 fathoms off the River Plate, few believe in such a depth (nearly nine miles—three miles more than the height of the highest mountain). It is supposed that during the time required to reel out the line (probably not less than two hours) the gallant captain drifted far to leeward.

Soundings can also be taken in much less time with a diver than with a line.

The principal feature of the diver here shown is that it announces its arrival at the surface by discharging a pistol the moment of its appearance. A silent diver might come up close by and not be noticed for some time. *a* is a stick of pine; *b* a smaller stick driven two inches into a hole bored in *a*; *c* a pine block hinged to *b*; *d* the sinker; *e* a wooden pin; *f* a lead tip. A pistol with a waterproof cap and a cork in the muzzle is tied to the top of *b*. A string from its trigger it attached to the upper end of *c*. Metal tip *f* has such weight that with the pistol on and the sinker off, *a* would float nearly vertical and be entirely submerged, leaving *b* projecting above the water. After the sinker is put on and all is ready, *c* must be held up by the hand till the instrument is let go. The pin *e* must be of barely sufficient strength to support the sinker so that when the diver strikes the bottom the pin is sheared off by the shock and the sinker slides away (the sinker should be very loose on *a*). The diver then rises to the surface. While in the water the block *c* is upheld by its own buoyancy, but as it pops out of the water it falls and discharges the pistol.

I have shown what is, perhaps, the simplest way of holding the sinker. If very muddy bottom, it should be suspended from the lower end of *a* by any kind of self-detaching hook.

The smallest possible size for pin *e* and the necessary size for block *c* must be determined by experiment on deck. If a hair-trigger pistol is used, a very small block will suffice. Try whether the pistol barrel and tube are watertight by leaving it awhile in a bucket of water and then discharging it.

Any registering apparatus and appliance for bringing up specimens from the bottom may be attached to the device.

As for the dimensions, the weight of the pistol being known, the other parts are easily determined. *b* must be strong enough to support the pistol, *a* have enough buoyancy to support *b* and the pistol and a metal tip *f* of, say, twice the weight of the pistol, *d* heavy enough to sink all.

As it is the misfortune for "new things" to fall in with careless or unskillful gentlemen in whose hands they don't "work," the writer would state that he is ready to prove this diver's action and accuracy.

S. N. **STEWART**,
Philadelphia.

THE WATER METER SYSTEM AND WATER METERS.*

Steam engines now pump millions of gallons of water through vast pipes often spanning wide rivers, or riding over hills and sinking into dales, enabling water to be conducted under immense pressure. Gigantic reservoirs now exist containing many days' supply and aqueducts of stupendous proportions cross rivers at a cost of millions. In the streets of cities millions more have been expended for the great distributing pipes, until, to supply water for the necessaries of life, the cost amounts to sums which seem almost fabulous.

Notwithstanding all this expenditure, gallons are run off to obtain a single glass of water, pipes are left open in sinks and closets, while few reflect that every gallon brought into a city and forced to high buildings is sent there at the expense of the taxpayer.

They do not comprehend that if five gallons of water are wasted for the one gallon really needed, by all consumers, the public works and the water taxes must be five times as large as is necessary. It is directly proved by the experience of London and Providence that about thirty gallons per day, per human being, is ample to supply all real needs, but in consequence of the system generally adopted by American water corporations, which put a price per year to consumers and allow them to draw all the water they choose, the quantity per person has steadily risen until it has reached in some cities the incredible quantity of 150 gallons per day.

Thus after time in many cities the public works have been doubled to cope with this increasing demand, but the limits have soon been reached, until water commissioners in despair have now seriously sounded the alarm. The public conscience has been appealed to, detectives and police have been sent from house to house in Chicago and other places, and fines and penalties have been inflicted to stop this waste, but all to no purpose. Every water report puts the waste at at least sixty per cent.

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* Abstract of a paper read by Mr. John Coleman before the Society of Arts.

The twenty-sixth annual report of the Board of Water Commissioners of the city of Hartford, in which it states that the average daily amount of water used and wasted, in Hartford, is equivalent to over one hundred gallons to each and every person—a quantity which no city in Europe approaches, and which is only equaled by two or three in our own country; that the cause of this waste was permitting the water to run in cold weather to keep the pipes from freezing; in summer letting the water run to cool it; from the extravagant use of hose and lawn sprinklers during the hours prohibited by the rules, and at all times from water closets.

The report states that it is impracticable to use water meters until one is invented which combines cheapness and a fair percentage of accuracy and durability. The same report shows the result of an investigation of this waste in the case of the average dwelling house in St. Louis, occupied by a family of six persons. The amount of water was measured when used in the ordinary way, and found to vary from 1,310 to 1,908 gallons per day. The amount consumed was then measured, when care was taken that there should be no waste in the closet, and found to be 738 gallons per day. Subsequently, the water was measured, when, as stated by a member of the family, a very free use of water was made, only ordinary care being taken to prevent its wasting, and the amount consumed was found to vary from 433 to 461 gallons per day. On the other hand, one day an account was kept of the amount actually consumed for useful purposes, and it was 178 gallons.

The evil of enormous waste is not one of mere dollars and cents, for water-works are depended upon against great conflagrations. But with the present distributive pipes through the streets we cannot let this waste continue and still maintain an effective fire pressure for hydrants, even though we had an indefinite quantity in our reservoirs. The pipes are too small so long as everybody is drawing *ad libitum* from them. You cannot play streams 40 ft. high from the hydrants in many parts of this city.

The hotels and large manufactories use enormous quantities of water, mainly legitimately, but if thousands of private users are running three gallons to waste for every one gallon really used, then hotels and manufactories are unjustly compelled to pay more than double what water ought to cost, and more than double what every body else is paying.

The cause of all this is, that city councils, in selling water to the community, do not make each person pay alike, for the quantity used and at the cheapest rate, and prevent him from getting more than others are entitled to who pay the same.

Apply to gas the same system that is applied to water and you would bankrupt every gas company in existence. Many persons would never trouble themselves to turn off the gas, but let it burn if it costs no more whether it burns or not.

The remedy for existing abuses is to be found in making users responsible, by measuring the water used through proper water meters. Then if they wish to waste it let them pay for it. The result would be to cut down the waste of sixty per cent., and this would be equivalent to doubling the water works.

In answer to the objection sometimes urged against reducing the supply of water to a reasonable basis, "That we must let the water run continually in many cheap buildings to prevent freezing of the pipes," he said that when men put up shambling tenements, to make large returns upon a small outlay, it is unjust to force the rest of the community to pay for the tenement man's meanness.

The constant cry of the demagogue who calls himself a practical man is, "Don't stint the poor man." But I do not wish to stint any one. Ascertain how much is actually needed, and then double it, but stop the waste somewhere.

He advocated the plan of having the city put one or more main meters in each house, and then let the owner of a tenement house put one on each tenant, and said that there always are a few difficulties in the way of any improvement, but they disappear before the light of experience.

The only important argument against the adoption of a general water-meter system has hitherto been, that no meter has been found sufficiently reliable under all circumstances to be depended upon. This has been in the main true, as proved by experience.

In Providence, where water-meters are used, it is found that 30 per cent of them must be repaired every year, and that the coming meter has not yet arrived.

Water meters in use up to this time are constructed upon two principles—the piston and the rotary; but in both cases we are trying to make a tight vessel in which to measure water by the mere contact of two pieces of metal in movement against each other. In both cases, the impinging, or sliding of two surfaces of metals against each other, is involved; and when two surfaces of metals rub each other, especially if there is mud or grit between them, as is liable to be the case in water meters, they wear leaky.

It is not practicable to remedy this by means of nicely adjusted springs and rings which require skill to keep them in order, as a water-meter must be left to itself in exposed situations; hence, the entire system of piston and rotary meters is fundamentally wrong in principle. He next proceeded to sum up the requisites for a water meter, stating that they should be:

First.—It must not wear or corrode, so as to allow water to pass through it unregistered.

Second.—Its action must not be affected by mud—a terrible element for water meters.

Third.—It should not let water that has once passed through it into the house pipes return again to the street mains to the loss of the consumer. This is a fault with nearly, if not quite all, meters in use. You can see how it affects the consumer, say in New York and even in this city in certain localities where after 10 o'clock in the morning, when everybody is drawing, you cannot get water above the second story of the building in such district.

At night, the water mounts higher to fill the pipes and is registered, then descends and remounts, and is registered with every variation in pressure; consequently a certain large percentage of water is registered over and over again.

Fourth.—A water-meter should have no stuffing boxes or gearing to wear out and get leaky, nor springs or cranks which corrode and get out of order.

Fifth.—It should not make objectionable noise, or produce concussion in the pipes, as the pipes, when suffering themselves from constant shocks, also conduct the noise over the house.

Sixth.—It should be able to withstand the rudest shocks and violent changes.

Seventh.—A water-meter should present but the smallest obstruction to the flow of water. There are many meters in use which reduce the flow of water from ten to forty-five per cent.

Eighth.—It should deliver water with a smooth and even flow—an absolute condition where fountains or motors are desired.

Ninth.—The expense for maintenance must be trifling.

Tenth.—The parts must be simple, durable and cheap. Of the hundreds of attempts to produce a good water-meter, no more than half a dozen have been found to approach in practice anything like success, and only two or three have been found by water boards to be worthy of adoption. But the city of Providence finds that thirty per cent. of all the meters were taken out and repaired during the year, and the Chicago report says that one thousand piston meters cost $17,000 for repairs in nine months' time, thus showing that the best types of meters thus far employed were unsatisfactory in durability, requiring great expense for repairs and causing great annoyance to consumers by interruption of supplies. They have also been very inaccurate, over-registering and under-registering under various pressures.

Mr. Coleman next explained the reasons why these imperfections should be expected in piston or rotary meters, and then said:

The true principle upon which a real water-meter depends seems to me to be contained in a quart pot. It is a tight vessel. You fill and empty it, refill and empty, and there you have an exact measure. If you have an india-rubber bag, and fill and empty it, you have the same principle of exact measurement.

The Spooner diaphragm meter is constructed on this principle. It is formed of two chambers, the upper one containing the valve mechanism, the lower one actuating the diaphragm and discs. The valve shaft which passes through the valve chest carries three valves, the centre one being double-faced. The valve chest is divided into three compartments, with four parts: thus at each movement of the valve shaft two parts are closed and two are opened, admitting the water to the measuring chamber on one side of the diaphragm and allowing the water on the opposite side of the diaphragm to pass out of the meter. The lower or measuring chamber is divided at the centre by a diaphragm of india-rubber mounted into concavo-convexed form.

The edge of the diaphragm makes the packing between the two castings forming the chamber. On one side of the diaphragm is a perforated disc, with the edges curved backward, so that all wear of the diaphragm against the disc is prevented. On the back of each disc there is a projection which rests on a stud, which is fastened to the shell of the meter, the disc sliding forward and back, moving in its action the lower end of the levers.

On the outside of the casting forming the upper chamber is placed the registering mechanism, actuated by one end of a lever that enters a recess in a horizontal moving bar; the other end of a lever enters the chamber and is worked by the moving parts of the meter. The water enters from the supply pipe into the upper compartment, and passes thence through an open port to, say, the right hand side of the diaphragm, which it moves slowly toward the left disc, forcing it against the lower end of the valve lever, thereby reversing the position of the valves and changing the flow of water to the other side of the diaphragm, when the operation of the moving parts of the meter exactly reverses. While the water is passing into the measuring chamber on one side, precisely the same quantity of water is being discharged from the opposite side of the diaphragm, the flow being smooth and without interruption. The meter discharges a uniform measure of water at each movement of the diaphragm under any variation of pressure.

Mr. Coleman claimed that this meter possessed the requisites for a water-meter which he had already enumerated, and then said: "It may be proper to say that my attention was called to this meter on my return to this country last autumn, and a request made that I should examine it professionally as a piece of mechanism. I did so, but insisted upon making a series of trials before giving a report upon its merits. Through the kindness of the Water Board, of Boston, we gave it long and exhaustive trials, and subjected it, among others, to the following unusually severe tests:

1. The rapid opening and shutting of the supply cocks, under a full head of water, made no difference in its accuracy.

2. The water was allowed to drop slowly from the outlet for fifteen hours and at the end of that time was found six cubic feet of water in the tanks and six cubic feet of water was registered on the dial. The water department reported a variation of about two per cent. under a very small flow, but this is readily accounted for by the air contained in the water. In addition, he presented the opinions of other water engineers in its favor, and then said: If we have succeeded in presenting any arguments which have convinced you that the water meter system is the proper method of selling water. I trust you will believe as I do that the meter invented by Mr. Spooner is an instrument on which municipal corporations may safely rely for accuracy and thorough durability, as well as for all of the good qualities which are indespensable in a water meter. In answer to certain questions, Mr. Coleman said that the diaphragm is composed of pure rubber, without any fabric, and hence is very durable. Any mud or sand that might accumulate is washed off by the water, since the diaphragm and the valves are vertical. The points that have to exert thrust are bushed with hard rubber and brass to prevent rust from blocking up the joints. They have been carefully testing it thus far, wishing to be sure that it was accurate and durable, before asking corporations to adopt it. The last patents were secured only four or five months ago, but the tests to which the meters have been subjected have been of extraordinary severity. He also stated that one of the meters constructed during the experimental stage of the invention has been in constant and successful use in Syracuse, N. Y., during the last six years.

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THE AMERICAN INSTITUTE FAIR.—Preparations are now being actively made for the fifty-first annual fair of the American Institute, commencing on Sept. 27. Applications for space are received daily, and present indications appear to point to an unusual display of machinery. In addition to the various American manufactures, some interesting exhibits relating to the silk industry, will undoubtedly attract attention. The building is to be provided with electric lights, and power for the machinery will be furnished by two boilers of the Babcock & Wilcox type, now in course of erection.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

OWING to the drought, the Athol, Mass., water company have restricted the use of water to family purposes, and have been obliged to lower the supply pipes in the reservoirs. Wells in different parts of the town are giving out, and there is serious complaint of short feed and water in pastures.

THE wells at the Isles of Shoals have dried up, and the hotels get water by steamer from the main land.

BLOOMINGTON, Ill., has a wonderful gas well.

BIDS were opened on the 28th ult. by the department of public works, Chicago, for supplying the city with fifty tons of lead for water-pipes. E. W. Blatchford offered to supply it $4.90, and J. N. Raymond at $4.77½ per cwt.

EASTHAMPTON, Mass., on the 29th ult., voted against water-works, as the people did not wish to incur a debt of $100,000, the probable cost of the proposed works. It is proposed to adopt a temporary expedient, which will involve laying three miles of pipes.

THE DISTRICT WATER-WORKS EXTENSION.—The engineer officers in charge of the extension of the conduit of the Potomac aqueduct and the building a reservoir north of Washington are now busy making preliminary arrangements for commencing operations, but have done nothing as yet which it would interest the public to know. Colonel T. A. Washington is surveying lines for the conduit and will soon make a report. The reservoir will probably be located somewhere between the Howard University and the Soldiers' Home, and will take about fifty acres of land to make it of the capacity required.

A MEETING of the stockholders of the Bodwell Water Power Company was held in Bangor, Me., Wednesday, Aug. 23. It was voted to purchase the Veazie property in Oldtown for $50,000 to be paid in cash in three installments, and to purchase that portion of the Milford Land and Lumber Co.'s property, specified in the article of agreement, for $75,000, to be paid for in the capital stock of the Bodwell Water Power Company. A meeting of the directors was held after adjournment of the stockholders' meeting. The directors have secured the services of Mr. James B. Francis, the eminent hydraulic engineer of Lowell, Mass., who is expected to visit Oldtown about the 29th of the past month and make a thorough and exhaustive examination of the property and report in regard to the best method of procedure.

THE special committee chosen to investigate the water supply question for Greenfield, Mass., were to report on the 31st at a meeting held for that purpose in Firemen's Hall.

FOND DU LAC, Wis., has one electric-light tower, 150 ft. high, in front of Court-House Square, just erected, and it is promised that the others will be finished and the city lit with electricity by Sept. 5.

THE excavation of the fifty-feet diameter well in the city of Winona for the water-works is completed, and the laying of the curb wall from the present water-line to the surface of the ground is the finishing process now being done. There are 15½ feet of water now in the well, which would give 11 ft. 3 in. at low-water mark.

FORT GRATIOT, Mich., will borrow $11,000 for water-works.

CAMPBELLSVILLE'S (Ky.) water-works are completed.

THE Cincinnati Gas and Coke Company are about to commence the erection of their new or supplemental station on the river bank, about four miles above Main street. The lot enclosed contains 2½ acres, and is at present known as the "East End Garden." The front or main building will be 408 ft. on Eastern avenue, with wings extending back on Main and Spencer 150 ft. Immediately in rear of the building will be located two "holders," each 130 ft. in diameter, flanked on either side by boiler houses and machine shops. Next south will be located the retorts house, 375 ft. in length by 90 ft. in width, to be built with an express view to the introduction of the "steam stokers," a valuable labor-saving apparatus invented by A. Q. Ross. Between this house and the river will be located the elevators, coke bins, coal-sheds, etc. On the river front will be built the coal elevators, by which the coal will be taken from the barges and deposited in the yards. Some idea of the magnitude of the work may be obtained by the statement that 8,000 perch of stone and 5,000,000 brick will be required for its completion.

THE new water-works at Hazleton, Pa., are nearly completed.

KANAWHA, W. Va., owns the best gas coal in the world, but yet her streets are unlighted, and her citizens go about with lanterns in hand, like historic heroes of old, hunting for places to put their feet.—*State Tribune.*

THE Cheboygan, Mich., water-works were tested for the first time on the 26th ult., and several streams were thrown with apparent success.

NUNDA'S (N. Y.) new water-works will cost $20,000.

CHARLESTON, W. Va., is to have a new system of water-works.

ESTIMATED that $30,000 of necessary $100,000 can be raised in Ann Arbor by private subscription for new water-works.

WATER FAMINE IN PITTSBURGH.—The water famine which has been prevailing in Pittsburgh at intervals for some time has at last reached a climax. A number of the most important manufacturing establishments have been compelled to suspend operations, and, besides the apprehensions that are caused from the danger to which the city is exposed from fire and other accidental causes, pestilence menaces us. The flow of water necessary to clear the sewers is stopped, and medical men express the gravest apprehensions from that fact. There is no prospect of permanent relief, and, though workmen are busy making repairs on the worthless water-works machinery and the authorities promise a remedy, the evil grows from bad to worse.

THE pumps which Dean Brothers, of Indianapolis, are building for the water company of that city, are made by them under a sub-contract, for W. E. Worthen, C. E., the contractor for the new machinery at the works. One set of the pumps is in place, having been constructed at the Davidson Pump Works in Brooklyn. The other two sets were ordered later, to replace two rotary pumps which were broken to pieces one night through carelessness. The order coming at a time when the Davidson Works were too crowded to fill it, the work was given to Dean Bros. The pumps are from Mr. Worthen's design, and work directly with the turbine shaft without the intervention of gearing. The large 5,000,000 gallon steam pumping engine, designed by Mr. Worthen for the same company, and built by Davidson, is now being set up in the engine room.

THE following are the bids submitted for doing the plumbing and gas-fitting work at the new Minnesota capitol. The gas pipe to be put in will aggregate nearly two miles in length. The bids were as follows: Sykes & Andrews, plumbing, $2,350; gas-fitting, 10½ cents per foot. J. C. Johnson, plumbing, $1,983; gas-fitting, 10½ cents per foot. George Dempsey, plumbing, $1,886.20; gas-fitting, 14 cents per foot. Prendergast Bros., plumbing, $2,179; gas-fitting, 12½ cents per foot. H. P. Rugg, plumbing, $2,600; gas fitting, 15 cents per foot. Kinney & Hudner, plumbing, $1,850. A bid of $1,814.40 for putting up the iron stairs was received from P. Herzog.

SWAMPSCOTT, Mass., wants water, but does not know whether to take it from a tubular well system or ask Lynn to furnish it. An adjourned informal meeting to consider the matter will be held September 6.

WORK has begun on the state-prison reservoir at Concord. It will hold 135,000 gallons of water, pumped from the Assabet River, and is being constructed by Phineas Ball, of Worcester.

MORE WATER FOR BROOKLYN.—Keeny & Valentine, contractors, are digging a well near Smith's Pond, at Rockville Centre, to provide an additional supply of water for Brooklyn. The well is to be 150 feet in circumference and will be 21 feet deep. It is believed when finished that the well will supply 3,000,000 gallons of water daily.

THE boring for the artesian well, to supply the village of Mount Vernon, Westchester County, with water for domestic and fire purposes, has been commenced, and promises to be very successful. The well is on Seventh avenue, near Third street.

ELECTRICITY.

MANCHESTER, N. H., has just introduced the electric light very successfully. The power is taken from a 400 horse-power water wheel, which is rented from the Amoskeag Manufacturing Co., and carried by a 4-inch shaft 400 feet to where the dynamos are located. The counter shaft runs at a speed of 510 revolutions per minute, and is fitted direct to the machine, a friction pulley being used to throw out the counter when necessary. The plant at present consists of 6 ten-light Weston machines, and the circuit is four miles long. There are 30 lights already running on 3 machines coupled together, giving great satisfaction. N. W. Ellis, M. A., S. C. E., is Engineer and Superintendent.

EDISON'S 396 PATENTS.—The largest number of patents issued from the U. S. Patent Office to any one man is to Thos. A. Edison. Last week he had 21 patents, making the total number issued in his name 396.

RIVERS AND HARBORS.

THE MISSISSIPPI RIVER IMPROVEMENT.—Dividing and Assigning the Work.—A special order has been issued by Gen. Wright, chief of the engineer corps of the army, with the approval of the Secretary of War, dividing the Mississippi River, between Cairo and the head of the Passes, into the following districts for the purpose of improvement and the construction and repair of levees: First district, from Cairo to foot of Island No. 40, to the charge of which Capt. John G. D. Knight, corps of engineers, is assigned, with station at Memphis or Cairo, at his discretion. Second district, from foot of Island No. 40 to mouth of White River, to the charge of which Capt. Alex. M. Miller, corps of engineers, is assigned, with station at Memphis, Tenn. Third district, from mouth of White River to Warrenton, the charge of which is assigned to Capt. Wm. L. Marshall, corps of engineers, with station at Vicksburg, Miss. Fourth district, from Warrenton to the head of the Passes, to the charge of which is assigned Major Amos Stickney, corps of engineers, with station at New Orleans, La. This district will include, besides the levees and special work on the river, the rectification of the Red and Atchafalaya rivers at the mouth of Red River. Capt. Miller is directed to transfer to Major Stickney the charge of the improvement of the harbor at Natchez, and to Capt. Marshall the charge of the improvement of the harbor at Vicksburg, Miss.

LIEUTENANT COLONEL C. B. COMSTOCK and Majors McFarland and Nelson, comprising the Board of United States Engineers to whom was referred the question of the protection of Erie harbor, report that there is no special danger to be apprehended, but recommend that an appropriation of $10,000 be made and held for the construction of a brush and stone dyke, with apron should a breach be made through the neck of the Peninsula.

SECRETARY LINCOLN has approved the recommendations of the Mississippi River Commission for the apportionment of the fund appropriated by the last Congress for improving the navigation of the Mississippi River, and it is supposed that the work upon the river will begin at once.

COLONEL PETER C. HAINS, U.S.A., the engineer in charge of the reclamation of the Potomac flats, submitted his project of operations to the Secretary of War on the 29th for his consideration and approval.

A BOARD of officers of the Corps of Engineers, to consist of Major Amos Stickney, Capt. Alexander M. Miller, and Capt. William L. Marshall, will assemble at Memphis, Tenn., on Monday, Sept. 4, or as soon thereafter as practicable, for the transacting of certain business connected with the building and repair of levees on the Mississippi River. On completion of this duty the members of the board will return to their stations.

REMOVING PORTLAND'S BAR.—The funds appropriated for the improvement of the Columbia River will probably not be available for six weeks; hence, the government dredge cannot be utilized. The work of dragging St. Helen's bar has been abandoned because the drag became disabled. But it is believed a plan has been hit upon which will force a good ship channel, viz., stirring the deposit with a steamship's propeller and allowing the current to carry it away while it is floating. The bar is formed of compact, clean sand. A sample was brought up yesterday and an experiment tried. A tablespoonful was thrown into a tumbler of water and the liquid stirred slowly. The sand rose to the surface and a portion remained floating after the water had become still. Mr. C. H. Prescott, manager of the Oregon River and Navigation Company, has tendered the use of the collier Walla Walla, which arrived yesterday. It is proposed to anchor the steamer bow up stream, the stern at the lower edge of the bar, and loaded, so that her keel will be on the bottom. Then the process of stirring the sands will begin. So soon as 100 feet in width is obtained the steamer will advance half a length and repeat the operation until the head of the bar is reached. Then she will be backed through the channel. In the dragging done by the Ocklahama no signs of logs were discovered. The bar is about 1,000 feet long, and the channel proposed to be cut will be with the current, instead of at an angle as heretofore obtained by dredging. The velocity of the current during flood tide is about two miles and during ebb tide about three miles per hour, and this is believed to be strong enough to carry away the sand as fast as it arises from the bottom.—*Oregonian.*

MISSISSIPPI RIVER COMMISSION.—The Mississippi River Commission met on the 21st, at noon, in the Army Building, in Houston street. General Gillmore presided, and the other members of the commission present were General Comstock, Major Harrod, Major Suter, Prof. Mitchell and Judge Taylor. Henry B. Richardson, Chief Engineer of the State of Louisiana, and Messrs. Kenner and Wilkinson, of the same State, appeared in the interest of levee-building below the mouth of the Red River. Mr. Richardson discussed the importance of building levees below, as well as above, the Red River, and said that funds available for the purpose from the State of Louisiana would be insufficient for the performance of the work. After some discussion of the subject a resolution was offered to allot $100,000 from the contingent reserve fund of $473,000 to repairing and building levees below the mouth of the Red River. This resolution was, however, voted down. The discussion then turned to the subject of the allotment of $1,300,000 made at the previous sitting of the commission in this city for building and repairing levees on the west bank, from the mouth of the Red River upward, and on the east bank from the mouth of the Yazoo River upward, and the following resolution was adopted:

Resolved, That it is the judgment of the Mississippi River Commission that the repairing and building of levees as set forth in the resolutions of the Mississippi River Commission adopted at their session held in the City of New York on the 14th, 15th, 16th, 17th and 18th days of August, A. D. 1882, should be done as a part of the plan of the commission to afford ease and safety to navigation and commerce of the Mississippi River and to deepen the channel, and that the Secretary of War be informed that the allotment of funds and the plans proposed at the said session were made in pursuance of such judgment of the commission then existing.

It was then proposed to adjourn until next morning, with a view to reconsidering the subject making an allotment for levee work below the mouth of the Red River, and much time was spent in informal discussion of the matter. Finally, Judge Taylor offered a resolution, which was adopted, recommending that $50,000 be set aside from the contingent allotment for the building and repairing of levees and for closing the outlets and crevasses below Red River which discharge into the Atchafalaya and its basin, such sum to be applied to the closure of such outlets as are nearest Red River and divert the largest quantities of water from the Mississippi. The commission then adjourned to meet in St. Louis on Sept. 8. The Secretary of War has decided that the bids for levee-building obtained in answer to advertisements by the Mississippi State authorities cannot be used for doing the government work, and, therefore, that bids must be advertised for under the provisions of the law relating to other river and harbor improvements. This law requires that advertisements for bids be made in various parts of the country for from 10 to 15 days. The commission was desirous of using, if possible, the bids received by the State of Mississippi, in order to save time.

AT the opening of the bids in New York for the extension of the jetties at the mouth of the St. John's River, Florida, and the construction of jetties at the entrance to Cumberland Sound, Georgia and Florida, F. P. Murphy, of Washington, was a bidder upon both works, his prices being as follows: In the first work, for mattress work per square yard, 99 cents, and for stone per cubic foot, $3.79; for the Cumberland Sound jetties for the same classes of work the prices were 97 cents and $3.74 respectively.

THE following bids were received by General Q. A. Gillmore, Lieutenant Colonel of Engineers U. S. A., for the improvement of the channel across the bar at the entrance into the harbor at Charleston, S. C.:

Name.	Mattress per sq. yd.	Stone-work per cu. ft.
E. T. Bangs	$0.80	$3.75
Egnert L. Viele	.79	3.50
George W. Rodgers	.63	3.24
E. L. Richardson	.56	3.30
A. M. Newton & Jas. H. Eckstein	.83	3.68
A. A. Howlett	.84	3.60

The work will begin on September 25, and must be proceeded with at the rate of $25,000 worth of work per month. The award has not yet been made, and the contractor will have to furnish bonds in the sum of $125,000 with two sureties.

STREETS, DRAINAGE, ETC.

WOMEN IN SANITARY WORK.—DRYDEN SPRINGS, N. Y., Aug. 29.—A number of ladies stopping here who are prominent in professional and philanthropic work have organized a "Woman's Sanitary Association," designed to be national in its purposes and scope. It proposes to agitate and promote measures of practical sanitary reform. Miss S. S. Nivison, M. D., was elected President. Mrs. C. M. Clark delivered a lecture on the "Economic Sanitary Arrangements of Paris and its Hospitals."

BAYONNE, N. J., is advertising for macadamizing its streets about $115,000 worth.

RULES FOR LAYING DRAIN PIPES.—The Board of Health of New York City insists upon the fulfillment of certain requirements in the laying of earthenware drain pipes connecting dwellings with street sewers. These requirements demand that the pipe shall be hard and salt glazed, sound, and cylindrical; at least ⅝ of an inch thick if 5 in. in diameter, and ¾ of an inch thick if 6 inches diameter. Pipe must be connected with hydraulic cement of the best quality. No "tempered-up" cement can be used. The pipes must be laid with such good alignment that the inspector can see through the entire line from the house to the sewer, and every section must be bedded in cement so as to have a firm bearing, not only at the hub, but along its entire length. The inside of the drain must be freed from all cement which may have oozed through at the joints, and from all other obstructions. Before the drain is covered notice must be sent to the Health Department by the owner or plumber, that the inspector may visit and examine the work, and the Board of Health will not approve or permit a drain which has not been examined by one of its inspectors and found to be properly constructed.

WASHINGTON STREET IMPROVEMENTS.—Bids were opened on Wednesday in the office of the District Commissioners for taking up and relaying such portions of the sidewalk on the north side of Pennsylvania avenue as may require the same, from First to Fifteenth street northwest; such sidewalks to be laid of stone or such composition as may be selected, about 10,000 square yards in extent. The bidders were as follows: P. Maloney, J. W. McKnight, A. L. Barber and H. L. Cranford. Bids were also opened for the improvement of Eleventh street east, from M to O streets south, on the west side of the railroad track. This work includes the straightening of 1,200 lineal feet of bluestone curb; taking up and relaying 1,200 feet of gutter flag; relaying 500 square yards of brick sidewalk, and the laying of 6,280 square yards of granite block pavement, the blocks being furnished by the District. The bidders were Wm. Hussey, John Cudmore, P. Maloney, and Wm. H. Mohler. P. Maloney got the contract at $6,718. Bids were also opened for laying a granite block pavement on Seventh street west, from Q to Boundary streets northwest. This work includes the grading and hauling of 3,600 cubic yards of dirt; taking up, rejointing and relaying 3,313 lineal feet of bluestone curb; laying new 64 feet of same; taking up and relaying 3,583 lineal feet of 12-inch gutter flag; laying 1,726 square yards new brick sidewalk; taking up and relaying 1,100 sq. yds. brick sidewalk; building 6 receiving basins; laying 300 lineal ft. of 12-in. sewer pipe; laying 3,746 square yards granite block pavement; taking up, sledging, and relaying 3,400 square yards rubble pavement, and taking up and removing 4,000 square yards rubble pavement. In this case the granite blocks are to be furnished by the District government. The granite blocks will be laid on the west side of the railroad track; on the east side of the track the rubble pavement will be taken up and broken, so that the pieces will pass through a 7-in. ring in their longest dimensions, and will be relaid on a bed of 4 inches of sand, with screened pebbles in the joints. The bidders on the work were John Cudmore, Thomas Joyce and W. H. Mohler. Wm. H. Mohler got the contract at $10,821.

RAILROADS.

THE Norfolk & Western Railroad Company will pay a tax to the State of Virginia this year of $78,000, as against $18,000 last year. This is by large odds the heaviest tax paid to the State by any of its railroads.

THE Lake Erie & Western Railroad Company has decided to build an extension of forty-one miles, from Bloomington to Peoria, Ill. This has long been under consideration, and it has been fully determined. It is the intention to push this important work through this fall, if possible. This will prove an important addition to the main line of roads.

THE final survey of the Grafton & Greenbrier Road, which is to connect the Baltimore & Ohio and the Chesapeake & Ohio Roads, is now being made.

WAPAKONETA, O., Aug. 28.—The incorporators of the Ohio River & Indiana Railroad have effected a temporary organization by the election of the following officers: James Wilson, Jr., President; J. C. Hassmier, Vice-President; C. W. Timmeriesch, Secretary; W. S. Rogers, Treasurer; C. A. Layton, General Attorney. Books for the subscription of stock will be opened at the General Attorney's office Sept. 23.

THE line from Calvert to Tecumseh, Neb., connecting the Atchison and Nebraska systems of the Chicago, Burlington & Quincy Road, materially shortening the line to Denver, was completed to-day. Contracts will at once be let for an extension from Tecumseh to the main Denver line, making another considerable saving in distance.

THE Port Chester & Tarrytown Railroad Company, capital $500,000, has been incorporated. The road is to run from Port Chester to intermediate points and to Tarrytown.

THE party who contracted to plow a fire guard from Ellis to Denver, along the line of the Kansas Pacific road, finished their work last week. They plowed eight furrows, which took them about two months and a half.

ROUTE OF THE CANADIAN PACIFIC.—One of the most important items connected with the progress of work on the Canadian Pacific Railway is contained in the following: Engineer Major A. B. Rogers telegraphs to President Hill, of the Manitoba Line, that he has succeeded in finding a feasible pass through the Selkirk or Gold Range, British Columbia. This discovery has immense value, as it determines the route of the Canadian Pacific, locating it about 100 miles north of the boundary line, directly east of Wamploops. From Wamploops it will be nearly an air line to Winnipeg and Thunder Bay. It will be about 100 miles south of Yellow Head Pass, thus doing away with the necessity of the far northwestern détour, as laid out by the government survey. This is the second summer that Major Rogers has spent in British Columbia. Everybody said he could not find the pass, but he has done it, and the Canadian Pacific authorities are happy.

THE Paducah & Chicago Railway Company has filed articles of organization in the office of the Illinois Secretary of State. The line is to be constructed from the Ohio River at Brooklyn, Massac County, by way of Big Bay, Golconda and Rock Quarry, on the Ohio River, in Pope County, and in Hardin County, through the valley of Hog Thief Creek and the Saline mines, to Shawneetown, and thence to a point on the Wabash River in Gallatin County, all in the State of Illinois. Principal office in New York; regular office in Shawneetown. Capital stock, $3,000,000. First board of directors: George S. Wilks, Jabez M. Woodward, Thomas S. Ridgeway, Robert Reid, Edward C. Elliott and Fredrick S. Myers.

A GALVESTON despatch says: "In an interview with President George Sealy, of the Gulf, Colorado & Santa Fé Railroad, he said the work on the Navasota branch from Leon to Navasota, where connection will be made with the Montgomery Central purchased by the Santa Fé, is progressing rapidly; also that as soon as engineers have determined upon the permanent line from Alvin Section to Houston that work would instantly begin on that line and be pushed vigorously. The distance from Galveston to Alvin is thirty miles, and from Alvin to Houston twenty-three miles, making a distance from Galveston to Houston by the new route of fifty-three miles.

WHEN completed the Northern Pacific will have 9,850 ft. of tunnels.

WOOSTER, Aug. 24.—About sixty contractors have examined the profiles and specifications of the Killbuck Valley Railroad, and have put bids on file for the construction of the road-bed. The contract will be awarded to-morrow.

THE ENTRE RIOS railway (Buenos Ayres), an American company, organized under a concession and Congressional guarantee, which asked for a certificate of the guarantee, after months and years of delay and innumerable false hopes, has been turned over to Congress, and, it is said, for the purpose of burial. All these things are full of instruction to the foreign capitalist, and, although for the sake of the country and ourselves we should like to see capital coming here for great works, yet until there is a change of policy we should advise against it.

THE contractors of the Sunbury, Shamokin & Lewisburgh Railroad made a big blast the other day, in pursuance of the work of grading, near Northumberland. A ton of dynamite and half a ton of powder were used and the explosion displaced 4,000 yards of solid rock.

EATON & ATKINSON, contractors on the Burlington & Ohio River Railroad, commenced grading at Gillespie on the 27th ult., the line from Carlinville, Ill., to Palmyra and Scottsville. Five hundred men will be at work by Sept. 1.

SEVERAL routes for railways from the West across the Alleghanies and through the Cumberland Valley to Baltimore have been surveyed.

THE Chicago and Northwestern road will soon open a new line to Hawarden, Spink County, D. T., this being an extension of the Watertown line.

DURING the third week in August 309½ miles of new railroad were completed, making 5,782 miles thus far this year, against 3,180 miles for a corresponding time in 1881.

THE European and North American road, to be leased by the Main Central Company, is 114 miles long. Fifty-nine miles are steel tracked, bridges have been rebuilt and the track ballasted.

THE route of the proposed Peoria and St. Louis Air Line Railroad has been surveyed from Pekin to Collinsville. The estimates are that the road can be built, ready for the rolling stock, for about $14,000 per mile, and completed and equipped for about $16,000 per mile. This last estimate contemplates steel rails and iron bridges.

THE ERIE CAR WORKS have a contract to build two hundred cars for the Northern Pacific Railroad, and are sending out nine a day.

PROPOSALS for the construction of the prolongation of the Don Pedro II. line between Itabira and Sabará, Minas Geraes, were opened on the 25th ult. Owing to a neglect to advertise, only a few were aware that proposals had been called for, consequently the competition was simply a farce. As it is a government job, however, the manner of effecting it occasions no surprise. *Rio News.*

CANALS.

THE FLORIDA LAND AND IMPROVEMENT COMPANY'S canal has just been completed to Lake Kickpochee, a large lake within three miles of Lake Okeechobee, and an immense body of water is pouring down the Caloosahatchee River amid great rejoicings. The completion of this work will bring into cultivation the finest sugar lands of Florida.

CONTRACTS LET.

BIDS for the elevator shaft in the Department of Justice, Washington, were opened in the office of Supervising Architect Hill. The following were the bidders and the amounts: Robert Davidson & Co., $4,425; A. L. Phillips, $4,429.50; George A. Cooke, $4,500; W. A. Hutchins, $5,184; Joseph T. Collins, $7,795; all of Washington. The contract will probably be awarded to Robert Davidson & Co., as they were the lowest bidders.

THE Commissioners and Trustees have awarded the contract for the building of a school-house at the Orphans' Home, two miles north of Wooster, for the sum of $6,000.

BRIDGE CONTRACT LET.—The Jeffersonville County Commissioners to day closed a contract with the Canton (Ohio) Bridge Company for the construction of an iron bridge over Silver Creek, at Blackiston's Mill, at $20 per lineal foot. The structure is to be completed by Nov. 1, at a cost of $3,356.56.

PANAMA, August 26.—Messrs. G. W. Shears, of Washington, D. C., and M. G. R. Fritz Gaetner, of Bonanza, New Mexico, have signed a contract with the government by which they undertake to clear the obstructions which now prevent the rivers Ulua and Blanco, in Honduras, from being navigated, and to put a steamer on them within one year, and subsequently to augment the number as may be required. In return for this service, the government concedes the contractors the sole right to navigate those rivers during twelve years, and grants them 2,000 acres of land, besides other lesser privileges. The contractors promise to carry immigrants into the country, but no number is stated.

W. W. REED, of Erie, has been awarded the contract to build the twenty-mile extension of the Shenango & Allegheny Railroad from Coalville Junction to Butler. The work has already been begun.

THE contract for the earthwork on the Lake Erie, Wooster & Muskingum Valley Railroad was awarded to J. J. Maney, of Alliance, O., for the sum of $23,000. There were about twenty-five proposals made by contractors, which varied but little. The distance is fifteen miles, the grade is uniform and the construction of the road-bed will be no difficult work. The line runs from Wooster, O., north to the junction of the N. Y., P. & O. Railroad. The contracts for bridging, tieing and railing the road will be let some time soon.

The contract for laying an asphaltum pavement and carriage concourse on the roadway in front of the White House has been awarded to H. L. Cranford for $8,442.76.

BUILDINGS.

BIDS for furnishing iron door and window guards for the lower story of the Treasury building were opened in the Supervising Architect's office. The following are the bidders and the amounts: E. N. Gray & Co., $3,195; C. A. Schneider, $3,491.73; Geo. White & Co., $3,606.55; Bartlett, Hayward & Co., $4,125.

HUNTINGDON'S new court-house is estimated to cost $71,300.

CITY HALL CONTRACTS.—At a meeting of the Board of New City Hall Commissioners, of San Francisco, the following bids were presented and opened for completing the internal work on the second floor of the Larkin street front: Hall & Cox, $16,600; Henry T. Bray, $15,966; J. Kemp & Co., $15,678; J. K. Delmas, $12,980; David Brown, $12,282. For completing the work, with certain omissions designated, the bids were as follows: Hall & Cox, $13,200; Henry T. Bray, $12,966; J. Kemp & Co., $13,045; J. K. Delmas, $10,477; David Brown, $10,280. The bids were ordered passed to print, and the Board adjourned until Monday, the 28th ult., when the contracts will be awarded.

THE contract for erecting an elevator in the southeast corner of the Post-Office Department, Washington, D. C., was awarded to Otis Brothers, the price being $7,500.

EFFORTS are being made to establish cotton factories at Darlington and Society Hill, S. C.

BRIDGES.

AT the Eau Claire, Wis., council meeting last week, an old ordinance for the building of three bridges across the Chippewa River and for the issuing of $50,000 was repealed, and a new one introduced calling for an election on the 7th day of September for the issuing of $50,000 bonds.

A RAILWAY BRIDGE COLLAPSES.—The railway bridge at St. Rose, on the Canada Pacific Railroad, between Montreal and Ottawa, collapsed on the 30 ult. while a freight train was passing over it. Several cars went through. No lives were lost. One brakeman was pitched into the river, but swam ashore. The bridge will be ready for traffic on Monday next.

THE mammoth railroad bridge at McKeesport, Pa., is now ready for the iron.

IT is proposed to bridge the Missouri River opposite Blair. A company has been formed to construct the bridge, and the contract is to be let immediately. The cost will be at least $1,000,000. The Northwest Company will be benefited by it.

THE NEW RIVER BRIDGE COMPLETED—HAMILTON, O., August 27.—The iron railroad bridge over that part of the Miami River known as New River, which has been in course of construction for the past year, has been completed, and last evening the first train passed over it, being a long heavy freight. Before any trains were permitted to cross, a thorough test was made yesterday by Colonel J. H. Barrett, Superintendent of the Cincinnati, Hamilton & Dayton Railroad, assisted by C. A. Darlton, Chief Train-Dispatcher, and Henry Golden, Superintendent of Construction. The test made by these gentlemen, and officially reported, is as follows: South Span.—First. Over this there were run four large engines at the rate of 5 miles per hour. During the crossing of the engines the deflection was one-half of an inch; lateral deflection, one-eighth of an inch. Second. Then four engines were sent across at a speed of 15 miles per hour, when the deflection was five-eighths of an inch, and the lateral deflection one-eighth. Third. The engines were then sent across at a speed of 30 miles per hour, when the deflection was fifteen-sixteenths of an inch; lateral de-deflection, five-sixteenths. North Span.—The four engines were sent across at a speed of 5 miles per hour, when the deflection amounted to three-eighths of an inch and lateral deflection one-eighth. At a speed of 15 miles per hour the deflection was seven-fifteenths of an inch and the lateral deflection one-eighth of an inch. At a speed of 30 miles per hour the deflection was three-fourths of an inch, and the lateral deflection three-sixteenths. Colonel Barrett, after completing the test, left on the 5:45 train for home, satisfied with the test and the strength of the new bridge.

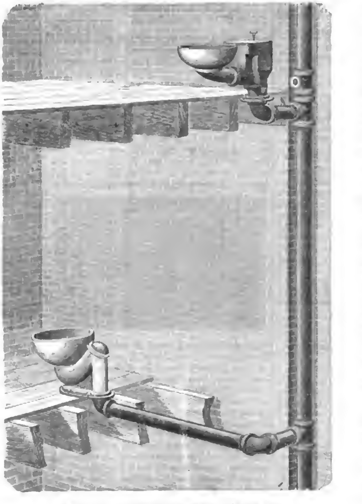
The following bids for building a stone arch over Gould's Run, on the River Road, near the Delaware and Bound Brook R. R. bridge were opened at the residence of S. H. Phillips, Esq., Ewingville, N. J. on the 28th ult.

William D. Morgan, Bucks Co. Pa., $1,599, and take all chances for extra work. William Johnson, $2,290, and take all chances, Trenton. Charles Kirby, $970, as per specification, and $4 per perch for extra, if any, Trenton. Henry Fransone, $1,250 as per specification, and $4.75 per perch for extra if any, Trenton. A. M. Walton, $890 as per specification, and $4 per perch for extra if any, Trenton. Contract awarded to the last bidder.

THE DURHAM SYSTEM OF HOUSE DRAINAGE.

In our issue of June 10, ult., we gave a general description of the new system of house drainage construction, which is part of the equipment of the marvelous young city of Pullman; for the further information of our readers we publish an illustration of some of the features then alluded to, showing the methods of connecting water-closets with the soil pipe so that no joint can be disturbed by settlement. All water-closets adjoining the soil pipe are supported directly from the soil pipe and are entirely independent of the floor for support. Water-closets at a distance from the soil pipe are supported by the floor, but connected with the soil pipe by a flexible point, so that settlement cannot strain any joint. Any good water-closet which does not require a *retentive* trap under it can be used in connection with this system; the contents of the closet must be discharged directly into the soil pipe without encountering an intermediate cesspool—for that is what the trap under the ordinary water-closet amounts to. All the upper piping in the Durham system is of standard wrought iron, lap welded, steam pipe, coated with asphalt: the drains are built of dipped cast-iron gas-pipe, weighing 15 and 25 pounds perfoot for 4-in. and 6-in. pipe. The soil pipes are supported directly by the drains into which they are screwed by means of an elbow connection; they stand erect and rigid, and have no connection with walls or partitions. The complete system is an apparatus which is entirely independent of the building for support, and absolutely invulnerable. Its introduction will undoubtedly displace the plumbing system now in vogue; for the public are in such a condition of exasperation and panic on sanitary questions that they are more than ready to accept a change which will bring a guaranty of immunity from sewer diseases.

The organization of the Durham House Drainage Company of New York is being rapidly proceeded with, and it is expected that they will be ready to execute contracts in October, after which time householders can elect whether they will or will not have an absolutely safe system of drainage in their houses. At present they are all at the mercy of the plumber.



The Durham System of House Drainage.

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BIDS FOR NEW SHOPS ON THE D., L. & N. R. R.

J. J. McVean, the Engineer of the Detroit, Lansing & Northern Railroad Company, has let contracts for building new shops at Ionia, Mich. From a ground-plan we take the following dimensions of the several buildings:

Round house, 250 ft. in diameter; turn-table pit, 50 ft. in diameter; open court, 120.8 ft. in diameter; locomotive pits, 4 × 35 ft.

The machine shops, 110 × 250 ft.; machine shop, 108 × 145 ft.; blacksmith shop, 40 × 95 ft.; boiler shop, 45 × 98 ft.; tin shop, 14 × 45 ft.; pattern shop, 15 × 47 ft.; hall, 12 × 15 ft.; office, 12 × 15 ft.; tool room, 15 × 34 ft. 6 in.; locomotive pits, 4 × by 24 ft.

Placed next to this is the transfer pit, 60 × 278 ft., with an iron table and six tracks.

The car repair and paint shop is 80 × 280 ft. The repair shop, 78 × 141 ft.; paint shop, 78 × 121 ft; paint and oil room, 14 × 66 ft. 4 in.

Boiler house, 47 × 47 ft. Chimney, 100 ft. high, with 5 × 5 flue.

Store, 20 × 100 ft.

The buildings are all of brick, except the wood-working shop, which is of wood, and contains all the wood-working machinery, with an engine to drive it, steam being brought from the boiler-house. The lumber yard is so arranged that the lumber can be taken from any pile directly to the above building, where it passes through the machines, to be dressed and fitted, then placed upon a car and taken directly behind the cars, being built in the car shop. There is a small tramway passing entirely around the engine-house and to the machine shop, thus avoiding the carrying of many articles. The machinery in the machine shop is driven by an engine in the shop, steam being furnished from the boiler-house. The buildings will be heated by steam from the boiler-house, where boilers of the Babcock and Wilcox type will be used.

The following were the bids upon the work.

Patrick Dee, Detroit, Mich	$110,730.00
Collins & Jaynes, Detroit, Mich	111,469.80
O. Waterbury, Ionia, Mich	115,092.52
Farr, Avery & Co., Grand Rapids, Mich	122,420.00
J. A. Moross & Co., Detroit, Mich	124,397.70
Dean Brothers, Detroit, Mich.	141,771.20
Fuller & Wheeler, Lansing, Mich	176,831.25

Contract awarded to Collins & Jaynes, Detroit. It is intended to push the work as fast as possible, as the present shops are in very poor condition.

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THE KINZUA VIADUCT.

The highest railroad bridge in the world, now being constructed on the extension of the Bradford branch of the New York, Lake Erie & Western Railroad, is now nearly completed. The bridge spans a deep ravine, at the bottom of which flows the Kinzua Creek, situated in McKean County, Pa., three miles from Alton, the present terminus of the Bradford branch.

The structure, when finished, will be 2,052 ft. long between abutments and 302 ft. high from the surface of the ground to the base of the rail. It is composed of continuous lateral girder irons, supported on twenty iron towers, formed by columns strongly connected together by bracing so as to give the greatest amount of strength and stability to resist pressure from wind and storms. These towers have a uniform length at top and bottom of 38 ft. 6 in., a width at top of 10 ft., and at the bottom the width varies with the height, the two highest towers having a width at their bases of 102 ft. 9 in., the width of the towers at their bases being uniformly one-third of their height from the top of the masonry on which they rest to the underside of the girders of which the truss is composed.

There are twenty clear spans of 61 and one of 62 ft. in length. Due provision is made for expansion and contraction, as in the girders of the truss on the plates connecting the columns at the base of the towers and to the masonry. The towers are firmly anchored to the masonry piers by heavy iron rods. The floor system of the viaduct, which is 20 ft. in width, consists of oak ties 8 in. in width and 12 in. deep, laid on the girders 8 in. apart, on which the rails rest. Every provision is made for safety by double timber guard rails, and an inside steel guard rail. On each side, outside the guard-rails, a sidewalk is laid and protected by a hand railing.

The weight of iron in the structure is 4,200,000 pounds. The masonry is all of a very substantial character, of a good quality of sand stone, which was fortunately found in close proximity to the work, and great care was taken to make the pier sufficiently large to ensure perfect stability. There are in all 112 piers and two abutments, containing 7,000 cubic yards of masonry.

The chief engineer of the work is Mr. O. Chanute, of the Erie Railway. The viaduct was projected by Mr. O. W. Barnes before the road passed into the hands of the New York, Lake Erie & Western Railroad. Mr. Charles Pugsby is principal assistant engineer; C. H. Keefer, engineer in charge of the work; W. Seamon, E. B. Rawson and C. E. Ball, assistants.

This viaduct was designed as well as constructed by Clarke, Reeves & Co., of the Phœnixville Bridge Works, whose design was selected by the officers of the Erie Railway as the best plan among several competing plans. The iron work will be all erected by August 31, and trains can cross in a week afterwards. This will be just four months from the time of beginning to erect iron. When it is considered that there are nineteen towers, six of which are higher than those of Brooklyn bridge, and that the viaduct is as long as from the City Hall to the Battery, this is a rapid feat of construction, and due entirely to American methods, no scaffolding of any description having been used.

The work of erection is being skilfully managed by R. A. Simmons, superintendent.—*The N. Y. Graphic.*

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TEMPERING STEEL.

Water mixed with ice gives the best temper to steel. One may insert some small tools to advantage in a lump of ice, as jewelers and watch-makers do when they temper them in sealing-wax. Often oil is used, and is preferable to water, because it is not as easily evaporated. Damascened blades are tempered in a strong current of cold air, passing through a narrow chink, a temper more uniform than with water being thus obtained. But of all the means for this purpose, it is believed the most efficacious is a metallic liquid, and, mercury being the only one known, and always a good conductor of heat, as well as the best of liquid conductors, it has come to be regarded as an unequaled bath for the temper of very sharp steel tools.

CONSUMPTION OF TIMBER.

It is estimated that, leaving out of consideration houses and other buildings and furniture, 100,000 cords of soft maple are annually worked up into shoe pegs; 190,000 cubic feet are converted into matches; last and boot-trees and tool handles require the use of 1,000,000 cords of birch, beech and maple, and in burning the brick which are to replace frame structures, 3,000,000 cords of wood are burned every year. Nearly 1,000,000 trees have already been made into telegraph poles, and 300,000 new poles are put up annually. The relations of the existing supply to consumption have been accurately calculated, and it is safe to say that unless economy is practiced or the amount of wood increased, the time is not far distant when wood will be very high and scarce. Plant more trees.

CORRESPONDENCE.

CORRECTION—ALGEBRAIC PROBLEM.

My answer to algebraic problem in ENGINEERING NEWS of Sept. 2 should be:

$$x = 3,\ y = 2$$
$$x = +3.6264,\ y = -2.1509.$$

S. C. W., Chicago, Ill.

ALGEBRAIC PROBLEM.

PITTSBURGH, Sept. 5, 1882.

EDITOR ENGINEERING NEWS:

I watched the responses in the last issue of your valuable paper on an algebraic problem, given by a reader of your paper in No. 33, Vol. IX., in form of two equations: $\begin{cases} x^2 + y = 11 \\ y^2 - x = 1. \end{cases}$ Last Monday I discovered some solutions for that problem, and being myself in possession of the correct answers, I intended to satisfy the questioner, for all of the solutions given in the last issue of your paper are incomplete and partly incorrect. The above equations are two associated equations of the fourth degree in reference to y and x, therefore we will have to find the four roots of either one of the two equations. For x and y, respectively, the equations of the fourth degree are:

$$\text{I. } x^4 - 22x^2 - x + 120 = 0, \text{ and}$$
$$\text{II. } y^4 - 2y^2 + y - 10 = 0$$

The four roots of these equations, and therefore of the two originally given ones, are:

$x' = +3;\ y' = +2$

$x'' = +3.626418$ and $y'' = -2.150911$

$x''' = -3.313209 + 0.229799\sqrt{-1}$ and $y''' = +0.0754559 + 1.522794\sqrt{-1}$

$$\begin{cases} x'''' = -3.313209 - 0.229799\sqrt{-1} \\ y'''' = +0.0754559 - 1.522794\sqrt{-1} \end{cases}$$

and will thus by pairs (same indexes belonging together) satisfy the two equations $\left.\begin{matrix} x^2 + y = 11 \\ y^2 - x = 1 \end{matrix}\right\}$ as trial may prove.

Respectfully yours,

F. MELBER, C. E.,
Keystone Bridge Co.

STAKING OUT SWITCHES.

UNITED STATES ENGINEER OFFICE,
21 Astor Building,
JACKSONVILLE, Fla., Aug. 29, 1882.

EDITOR ENGINEERING NEWS:

Your correspondent "F. D." asks in the last issue of your paper: "What is the practical work for staking out a switch on the ground, frog being on the ground, and for the various ones now in use?"

Your correspondent has not stated the conditions as fully as is desirable, but it is presumed he is limited in his frog angle by the different frogs he happens to have on hand, supposed to be a limited number of different angles. This being the case, "F. D." is referred for the theoretical part of his problem to "Henck's Field Book," Prob. 51, Page 33, where, the frog angle being given, it is required to find the radius of the turnout curve and the position of the point of the frog.

The first thing is to find the radius R of the center line of the turnout curve. To find this he must have the following data:

The gauge of the track $= g$.

The "throw" of the switch rail $= d$, which is generally taken as 5 inches.

The angle which the switch rail makes with the main track $= S$, which varies, of course, with the length of the rail. This length varies from 18 to 30 ft.

The frog angle $= F$.

The radius R of the center line of the turnout is then found by Henck's formula, adapted to logarithms:

$$R + \tfrac{1}{2}g = \frac{\tfrac{1}{2}(g - d)}{\sin.\ \tfrac{1}{2}(F + S)\ \sin.\ \tfrac{1}{2}(F - S).}$$

From this we have R by subtracting the value of $\tfrac{1}{2}g$.

We now proceed to compute the position of the point of the frog, which is located in reference to the throw or mouth end of the switch rail.

Referring to the figure we will call the distance from the mouth of the switch to the point of the frog BF.

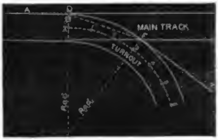
Then BF by Henck's formula $= \dfrac{g - d}{\sin.\ \tfrac{1}{2}(F + S)}$

We are now ready to stake out the switch or turnout. Two cases may occur.

1st. The location of the switch throw may be fixed.

2d. The location of the frog in the track may be fixed.

In the first case the position of the switch throw being fixed, we will drive a hub with nail in the center, x of the proposed turnout opposite the switch throw, determining its position by measuring from the rail one half the gauge of the track plus the throw of the switch, which last we will consider to be five inches. Theoretically, this should be measured at right angles to the position of the switch rail in the turnout; but, practically, it can be measured at right angles to the rails of the main track. Mark a point D on the inside of the rail of the main track opposite this for the end of the switch rail, and measure back on the iron the length chosen for the switch rail, and mark a point A on the inside of the rail for the heel of the switch rail. The length of the switch rail is generally 20 or 22 ft., but this may be varied to save cutting the iron. Short switch rails are more easily worked and are safer, but less than 18 ft. is objectionable, as not apt to make a smooth running curve and liable to jar the train. We now measure off the chord BF, which we have previously found by computation, from the throat of the switch, and .42 of a foot from the inside of the rail of the main track, swinging in the dist. BF to such a point F as it will touch the inside edge of the rail of the main track. This gives the position of the point of the frog in the track, which we mark on the rail.



The section master will set the frog in the track at this point without further marking.

We now set up the transit on the hub at x and lay off the curve of the turnout—the radius of which we have already computed—by setting stakes in the center line every 12½ ft., using a parallel to the switch rail in its position in the turnout, for tangent and deflecting as usual.

We know the radius of the turnout, and we can consequently compute the ordinate for bending the rails by the formula on Page 14 of Henck, $m = \dfrac{\tfrac{1}{4}l^2}{2R}$, in which m equals the ordinate required in decimals of a foot, and l equals the length of the rail used. It can also be taken from Table I (*ibid.*).

The angle S which the switch rail makes with main track is easily computed, as we know or assume the length of the switch rail and the throw of the same, and therefore $\sin.\ S = \dfrac{d}{l}$.

The frog angle F is known or easily found by measuring the frog, and computing, or by taking a paper pattern of the point angle and applying a protractor.

In the second case, where the point of the frog is fixed in the main track, we have to locate the switch throw from this point by measuring back the chord BF to a point B, 0.42 ft. from the main track rail.

In the case of a switch with a double throw, where two turnouts leave the main track from the same point, it is well to paint the stakes of each turnout a different color, to avoid confusing the trackmen.

We have supposed the main track to be on a straight line. If the turnout is from a curve the problem is more complicated, but it can be easily solved by Prob. 57, Page 38, Henck.

If "F. D." is limited for any reason in the length of his radius, then he must proceed by Prob. 50, Page 32 (*ibid.*), and trust to chance to have one of his frogs fit the frog angle required.

As a check upon the somewhat long computation required when the turnout is from the inside of a curve I have sometimes adopted the following mechanical method of obtaining the position of the point of the frog and the frog angle:

I set up the transit on the switch throw at B and lay out the outer rail of the turnout by deflection angles to any assumed radius, finding the point of the frog by repeated trials of deflection, and then measuring the frog angle by means of a light board with a nail driven through it at the point of the frog. This nail in the board is set over the point of the frog when found, and a pattern of the frog angle made on it by means of deflections with the transit, to establish the curve on the board. From this curve the tangent T at F is laid off and the frog angles measured with a protractor, or otherwise.

This method uses the rad. for the outer rail only, and saves computation for the frog angle and position, but is not applicable in the case given by "F. D." unless he is restricted to a certain radius.

The method I have described makes the turnout curve tangent to the switch rail, and consequently compounds the curve from B to A. This is no practical detriment, for generally the difference in radius is very slight, between the radius of the switch rail and the rest of the turnout, which is more than overcome by the manipulations of the trackmen.

Some engineers, however, prefer to make the curve tangent at the heel of the switch rail A. In that case the throw of the switch rail must sometimes be slightly changed (only a slight change is admissable with ordinary iron) or the length of the switch rail must be changed. But for safety in traffic the length of the switch rail should not be much increased, and if diminished nothing is gained.

Respectfully yours,

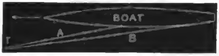
J. FRAS. LE BARON, U. S. Ass't Engineer.
Formerly Chief Engineer Fitchburg R. R. Co., Boston.

HOW TO TOW A BOAT.

Those living on swift streams, and using small boats, often have occasion to tow up stream. So do surveyors, hunters, campers, tourists and others. One man can tow a boat against a swift current where five could not row.

Where there are two persons, the usual method is for one to waste his strength holding the boat off shore with a pole, while the other tows. Where but one person, he finds towing almost impossible, and when bottom too muddy for poling and current too swift for rowing, he makes sad progress.

The above cut shows how one man can easily tow alone. The light regulating string B passes from the stern of the boat to one hand of the person towing (T). The tow-line A is attached a little in front of the centre of the boat. Hence when *B* is slackened the boat approaches the shore, while a very slight pull on it turns the boat outward. The person towing glances back "ever and anon" to observe the boat's line of travel.



S. N. Stuart, Philadelphia.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page 309.*)

CCCLXXVIII.—MOUNT VERNON, O.

Mount Vernon, Ohio, in lat. 40° 30' N., long. 83° 30' W., is on the Kokosing River.

Water-works were built by the town in 1882, taking the supply from the river, and pumping it by a Worthington compound duplex engine, with an auxiliary high-pressure Worthington engine, into a stand-pipe 25 ft. in diameter, and 56 ft. high, on a hill 125 ft. above the general level of the town.

Distribution is by 4 miles of cast-iron pipes of from 12 to 4-in. diameter, with 20 fire hydrants and 300 taps. Lead service pipes are used. The population in 1880 was 5,400. The works cost $50,000, and are controlled by three trustees, elected by popular vote.

The works went into operation in July, 1882.

(TO BE CONTINUED.)

◆

A BOAT SURVEY OR RECONNOISSANCE OF PEACE CREEK AND CALOOSAHATCHIE RIVER, FLORIDA.

Extract from the report of J. Francis Le Baron, U. S. Assistant Engineer to W. G. Williamson, U. S. Assistant Engineer, on the survey for a steamboat route from the St. John's River to Charlotte Harbor, on the Gulf of Mexico, made in June, 1881.

* * * * * * * * * * Owing to the short time remaining and the small balance of appropriation left, a boat survey or reconnoissance was decided on. My plan for this survey was as follows: Before leaving Ft. Meade, I had made a boat tripod, consisting of three short legs, which were fastened in the tripod head of the transit in place of the regular tripod legs, which were taken out.

This tripod was set up in the stern of one of the boats (two boats were used, each 14 ft. long, flat bottomed and made exactly alike) exactly on the centre line from stem to stern, distant 3 ft. from the stern, and was kept securely in place by toe screws through the feet of the tripod and into the bottom of the boat. This gave an opportunity for the observer to sit on the stern seat of the boat and use the instrument. In the other boat the folding telemeter rod was placed in the same relative position, facing the stern, and was held in place by an upright mast about 4 ft. high, furnished with a socket to rest the foot of the rod, and buttons near the top to clasp it without obscuring the figures. The telemeter rod could easily be removed from the mast, and the mast could be unstepped and taken out when necessary to pass under obstructions. Each boat was provided with a becket rope 3 ft. long (double), fastened to the stern. In using this arrangement the boat containing the telemeter rod was sent ahead to the next bend in the creek, when it tied up by casting the becket over a projecting root or snag, in such a position as to allow it to be easily seen from the boat astern containing the instrument, and where it could also command an unobstructed view down the river to the next bend.

The boot was held firm with poles, and the becket rope being drawn taut, the telemeter rod was unfolded and raised at the hinge, and a reading was taken through the transit from its position in the rear boat. In this way the distance was obtained and the compass course was then taken, the width of the river estimated at the instrument station, and the topography sketched in. This being accomplished, we were ready to proceed. The signal was given, the forward boat cast off and moved on, leaving a white flag tied on the root or snag over which tha becket had been cast, in order that we might be able to identify the station, which we then proceeded to occupy, while the forward boat went ahead and picked out a new station. If a projecting snag or root was not available a stake was driven in the bank on the edge of the water and the becket cast over it. In this manner the transit was placed over the same position occupied by the telemeter rod, if care was used in drawing the fastening ropes, or becket, at the stem of each boat, taut, and in holding the boat firmly up to the bank, and very accurate results could be obtained for this class of work.

We found we could easily run five miles per day and sometimes more, in clear parts of the rivers where there were long reaches, and no wind to render the boats unsteady by wave motion.

Soundings were taken constantly in the center of the stream, or on the course, and timed and recorded by an assistant and leadsman.

This survey required the following party. The Captain of the party, using the instrument and taking notes and sketching topography, counting and recording swags and leaning trees, and directing the survey.

A record of soundings, and time keeper.
One rod-man.
One leadsman.
Two boatmen.
Six men in all.

The camp equipage, provisions, &c., were carried in the boats.

Class sections and surface velocities were taken frequently and the volume computed by the usual formula:

$$\frac{\tfrac{4}{5}\text{ surface velocity per min.} \times \text{area of cross section}}{.134} =$$

= number of gallons per min. discharge.

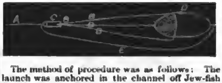
Where rapids or falls were encountered the forward boat was sent ahead to the foot of the fall, and the difference in level taken by the level on the transit telescope, reading on the telemeter rod without removing the transit from the boat, the telemeter rod being held over the side on the surface of the water and a constant correction being applied for the height of instrument above the surface of the water above the fall.

TRACK SURVEY OR RECONNOISANCE OF THE CALOOSAHATCHIE RIVER, FLA.

I commenced this survey on June 28, 1881, at Jew-fish Bayou, the upper limit of the coast survey "Chart of San Carlos Bay and the Entrance to the Caloosa River."

As this work was intended for a rapid reconnoissance only, it was decided to make a survey by means of the steam launch Spitfire, 57 ft. long by 10 ft. beam long, which was placed at my disposal. Such a survey is denominated a "track survey" in nautical surveying.

The Caloosahatchie River is here an estuary, varying from 1½ to 3 miles in width.



The method of procedure was as follows: The launch was anchored in the channel off Jew-fish Bayou, and bearings taken to all the points in the vicinity shown on tha coast survey chart, and to the end of the wharf at Punta Rassa. The intersection of these bearings determined the position of the vessel on the chart. I then measured the velocity of the tide with a sailor's log and seconds watch. The launch was then got under way and we proceeded slowly, and with only about 50 pounds of steam to run out the channels and traverse the shore, taking bearings with the mariners' compass belonging to the launch, which I had previously tested by our compass and found correct.

Distances were measured with a seaman's log, constructed as shown in the sketch, of canvas, and so arranged that by giving the cord *A* a sharp jerk, the lanyard *B* was drawn out of the friction clutch *C*, and the log was reversed in position, tha log *D* being emptied and easily drawn in by the stay rope *E*, fastened to the bottom.

The log line was furnished with "knots" 51.3 ft. long, and the passage of these knots were timed with a seconds watch; 1.5 ft. was allowed for "drag." This gave 52.8 ft. run in x time, which, being $\frac{1}{100}$ part of a mile, was chosen as a convenient number for use in computations. Several repetitions were made in order to reduce error, and the mean was taken for the velocity of the vessel, corrected by the observed velocity of tha current + or —

The time run on each course was accurately noted, and the launch was kept on the true course by ranging distant objects on shore, in this way correcting the tencency to drift when crossing obliquely to the current.

The distance of the launch from the shore was carefully estimated at the end of each course, and the topography of the banks noted and sketched.

Cross bearings from different positions on the same course were frequently taken to islands and prominent points and land-marks, and also at right angles to the course of the steamer, and the distances estimated, and the width of the river was carefully estimated at numerous places. By means of the cross or oblique bearings from different points on the course to the same point on shore, a kind of rude triangulation was effected.

The launch was often brought to anchor, and the velocity of the current taken, either with the log or by timing floats passing from tha stem to the stern of the steamer.

Connections with the U. S. land surveys were made at Fort Myers and other places to check the work.

Soundings were taken continuously and recorded, while the steamer was under way, and the tides read by an observer on a tide gauge set on Beautiful Island shoal.

This survey required the following party:

The Captain commanding, occupied in taking notes, timing the log, sketching topography and directing the survey. One recorder of soundings, also time-keeper. One pilot of the launch, at the wheel and calling the courses. One steam engineer. One leadsman. One observer, observing the number of revolutions of the main shaft and the steam pressure, and calling changes in the velocity. Two sailors; one in charge of tha log line, and recording snags and leaning trees. One cook. Nine men in all.

The party, of course, lived on board the steamer. Cross sections were frequently taken, and velocities with computations of volume of discharge.

We found we could easily run 20 to 30 miles of river per day.

◆

THE MAHMOUDIEH CANAL.

It was cut, by command of Mahomet Ali, in the year 1810, the destruction of the old one, eighteen years previously, having ruined Alexandrian trade by isolating the city from the grand old river. After the death of Sir Ralph Abercombie, when the British were trying to dislodge the French troops from Alexandria, they cut great sluices in the banks of the canal near Damietta, intending thereby to cut off the garrison from communication with the rest of Egypt, as also to stop the supply of fresh water. In the rush which ensued the waters of the Lake Aboukir were drained down the ancient bed of the Lake Mareotis, producing a vast inundation to the east and south of the city—a new feature of the country, which the French soon turned to their own advantage, bringing a flotilla of gun-boats to work on this newly created sea. So the Pasha very wisely determined to make a new canal; but he showed neither wisdom nor mercy in the way he set about it. Vast multitudes of these poor, hard-worked and much-oppressed fellahs, about whom we have lately heard so much, were gathered together—250,000 men, women and children, half naked, were forced to work in the burning sun, under command of brutal task-masters, who, as in the days of Pharaoh, did not hesitate freely to use their scourge of cords to encourage the weary. Not the men only, but women and little children, were lashed until they literally streamed with blood. No regular tools were provided; each brought his own poor basket of palm-leaves to carry away the sand and mud, which they scooped up with their hands. No wages were given, and only the most miserable food; so it was small wonder that, by the very lowest computation, 23,000 of these poor wretches perished from starvation, disease and exhaustion. Their bodies being shoveled in with the sand and mud helped to raise the canal banks, making them at the same time into a horrible, ghastly cemetery. But the fifty miles of canal were completed in one year (some accounts say in six weeks), and human life in Egypt is of small importance when balanced against a great man's will. From first to last these Egyptian canals have weighed heavily on the laborers; for what with artificial lakes and rivers, means of locomotion or of irrigation, each successive generation seems to have devised for itself some new experiment in water-works. In the very first reign of which we have trustworthy historical records—namely, that of Menes, who lived about five hundred years before Abraham—we find him undertaking, and successfully accomplishing, a trifling little alteration in the position of the Nile.—*Gentleman's Magazine.*

◆

THE STATE GEODETIC SURVEY.

Bethlehem, September 7.—Professor Mansfield Merriman, of the Lehigh University, civil engineer in charge of the geodetic triangulation of Pennsylvania, arrived in town yesterday. During tha summer the survey has been carried on in Lancaster, Berks, Lebanon, Schuylkill and Columbia counties, and is now being extended westward of the Susquehanna River.

◆

BANQUET TO THE MINING ENGINEERS.

Denver, Aug. 30.—The eleventh annual meeting of the American Institute of Mining Engineers closed last night with a grand banquet, given at the Windsor Hotel by a committee of citizens. The members, numbering about one hundred, arrived in Denver August 18, since which time they have visited the Exposition and many of the principal mining towns of the State. They also examined many famous mines, smelting, sampling and reduction works, and the Bessemer Steel Works.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, SEPTEMBER 9, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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WE PUBLISH this week a brief description of the Kinzua Viaduct, just finished by the well-known bridge-builders, Messrs. Clarke, Reeves & Co., of Phœnixville, Pa. The description is from the N. Y. *Graphic*, which also illustrates the structure in a page full of cuts, which, while giving a general idea of the structure, is not of any practical value to an engineer who may wish for details.

MEXICAN RAILROADS.—The general impression has been that the people of Mexico have done but little to aid in the development of their country by railroad building. In contradicting this a Mexican journal makes the statement that thirteen of the twenty-seven lines now constructing are being built by home companies furnished entirely with home money. It says:

"While ready to confess that this spirit of enterprise, this desire to invest our native capital in railroads, is the result of seeing American enterprise and capital coming into our republic, we claim that it is a notable sign of Mexico's progress, an unequivocal proof of the stability of our government, and a fact that marks an era in our history. And while we look back upon our past as showing the ordeal through which Mexico has had to pass to regenerate herself from the many evils bequeathed to us by the old colonial regime, we cannot refrain from here paying our tribute of gratitude to General Porfirio Diaz as the President who gave this new life to the Republic, and to General Gonzalez as the President who has so ably continued the noble work begun by his predecessor and comrade. Mexico is bound to have railroads, and railroads that will pay the shareholders handsome returns, if properly managed in the operation. We would make only one suggestion—and that is, that the companies should employ all the Mexicans they can."

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MODERN SCIENCE.

The fifty-second meeting of the British Association for the Advancement of Science, was opened at Southampton on the 23d ult. Considering the brilliant accomplishments of many of the members of this association, in every branch of science, its proceedings are watched with keen interest, and the opinions of its speakers received with that respect and attention which are only inspired by the leaders in the intellectual world. The rapid advance of science, following as a natural result of the labor of legions of devoted men, cannot, except in a general way, be kept track of by any one student. We find in the address of Dr. Siemens, the president-elect of the association, a résumé of the most important improvements and discoveries during recent years. Remembering the high and well-deserved position occupied by Dr. Siemens, we cannot but give heed to his remarks, especially when touching anything in the future.

In regard to the measures of length and weight, it was considered a circumstance to be regretted that England still stood aloof from the movement initiated in France toward the close of the last century; but the speaker ventured to hope that as the metric system had been almost universally adopted in scientific work and legalized in England, its adoption for commercial purposes would soon follow. Such a measure would be of great advantage to trade, particularly in the matter of machinery and metals rolled to current sections, which are now almost excluded from the continental market, owing to the measure employed in their production. The main obstruction to the use of the meter is the fact that although it is legal to use it, and a copy of the standard meter is kept in the Standard Department of the Board of Trade it is impossible to procure legalized rods representing it, and to use non-legalized copies is fraudulent. Dr. Siemens asked if it would not be desirable for the association to endeavor to bring about the use of the meter and kilogramme, and, as an initial step, to petition the government to be represented on the International Metrical Commission. For the purposes of science the electrical measures are next in importance to those of length, weight and time. The distinct lines dividing conductors from non-conductors of electricity, the magnetic from the non-magnetic substances, enable the electrician to measure quantities and effects with great precision, and, although the nature of this form of energy is still wrapt in mystery, its laws are clearly established and its measuring instruments amongthe most accurate in physical science.

In the matter of electrical units, the recent International Electrical Congress held in Paris decided to retain the practical units "ohm" for resistance, and "volt" for electromotive force; the intensity of a current produced by one volt, and a resistance of one ohm, to be called "ampere," and the quantity of one ampere in one second of time to be called a "coulomb;" the expression "farad" indicates the capacity of a condenser which holds one coulomb of electricity when laden with a volt. As representing the unit of intensity the term "weber" was dropped by the congress. Dr. Siemens proposes two new units; the first the unit of magnetic quantity or pole to be called "weber," and the other that of power to be called a "watt."

Electricity is considered the best form of energy for transmitting an effect from one place to another, and, as it passes through certain metals with a velocity only retarded by the the influence caused by the electric charge of the surrounding dielectric, and refuses to pass through oxidized substances, it is easy to confine it within bounds. The current from a small battery, entering the Atlantic cable, prefers the long journey to America in a good conductor and back again through the earth to the shorter passage through an insulating material only four millimeters thick. The changing of electrical into mechanical energy can be accomplished with no further loss than that resulting from friction and the heating of wires. These do not exceed 10 per cent. in a properly constructed dynamo, and it is believed they than can be further reduced. Taking all the losses into consideration, there could be used as effect at a distance more than 50 per cent. The author argued that a loss of 50 per cent. did not stand in the way of such applications, as a powerful central engine would produce one horse-power per hour with a consumption of two pounds of coal, while small engines distributed over a large area would consume five pounds. This leaves a margin in favor of electricity. Under certain conditions the electric railway possesses advantages over heat as steam power, but it will not in its present condition compete with with steam upon railroads. The deposition of metals from their solution is one of the oldest applications of electricity, though only recently has the dynamo current been used for this purpose. Although electricity could be employed for heating purposes, it would be useless to put it in competition with direct combustion of fuel. Its advantage consists in the seemingly unlimited degree of heat obtained. By its aid tungsten has been melted and eight pounds of platinum reduced to a liquid state in 20 minutes. Considering how much has been said and written concerning electric light, the author confines himself to a few remarks. The introduction of the secondary battery removes the objection frequently urged that it is dependent upon the continuous motion of gas or steam engines. This promises to achieve for electricity what the gas holder has for gas, and accumulator for hydraulic transmission of power. Even if the electric light should be produced so that it would cost no more than gas, Dr. Siemens thinks that gas lighting will hold its own as the poor man's friend. It is thought that the time is not far distant when both rich and poor will resort to gas as the cleanest, most convenient and economical of heating agents, and when raw coal will only be seen at the colliery or gas works. In cases where the place to be supplied is within 30 miles of the colliery the gas-works may be situated at the mouth, or, what is still better, at the bottom, of the pit. This would avoid all haulage, and the gas, in its ascent from the bottom, would acquire a pressure sufficient, probably, to impel it to its destination. The feasibility of sending gas through long lengths of pipe has been successfully tried at Pittsburgh. The annual value of the bye-products of gas manufactured in the United Kingdom is £8,370,000, or £3.000,000 more than the value of coal consumed. In using raw coal for heating purposes these products are totally lost, and in their stead appear the smokes so common over London. It is a foregone conclusion that wherever smoke is, fuel is being wastefully consumed. Gas would obviate this. The use of gas as a fuel has resulted in both Paris and Glasgow in a reduction of the time for effecting each distillation. This enables a given number of retorts to produce a quantity of heating gas in addition and equal to the former quantity of illuminating gas, resulting in a greater production of valuable bye-products and at a lessened cost. A pound of gas yields in combustion 22,000 heat units or just double the heat from a pound of common coal.

It is stated that before many years shall have passed we will find engines with a fuel consumption of not more than one pound of coal per horse power per hour, in which the gas producer will take the place of the steam boiler. The advent of such an engine and the dynamo will mark an era of progress equal to that effected by the introduction of steam power. Dr. Siemens alluded to the leading engineering undertakings of the present, to improvements in explosives, electrical discharges, and to the possible existence of aqueous vapors or hydro-carbons in stellar space.

PERSONAL.

Wm. W. W. Wood, Engineer-in-Chief, U. S. N., was drowned at Point Lookout, Va., on the 31st ult. The deceased was the owner of a large farm at St. Inigoes, and it was his custom to spend a portion of the year there. His residence commanded a fine view of the Potomac. On Thursday of last week he started with a friend in a canoe for a trip down the river. The boat was struck by a flaw, capsized, and before assistance could be rendered Com. Wood had sunk beneath the water.

Commodore Wood was born in North Carolina, and was sixty-five years old. He was appointed from New York, March 15, 1845, entered the service with the rank of chief engineer; was stationed at the navy yard, Pensacola, from 1845 to 1847; was on special duty at Boston in 1845; was with the steam frigate Saranac, of the home squadron, from 1850 to 1853; superintended the construction of the engines of the steam frigate Merrimac, at Cold Spring, New York, from 1854 to 1857; was on special duty at Philadelphia from 1858 to 1859; was with the steam sloop Lancaster, of the Pacific squadron, from 1859 to 1861; on special duty at Philadelphia, New York and Boston from 1862 to 1865; at the naval academy from 1866 to 1867; navy yard, New York, 1868 to 1869; inspector of machinery afloat, 1870 to 1872; engineer-in-chief of the navy, 1872 to 1877. He was on special duty in Washington at the time of his death. Deceased leaves five children. His three daughters married Lieutenants Heald, Stone and Reich, U. S. navy. His eldest son, Lieut. Thomas Wood, U. S. navy, is in California, and his other son, Frank, is with Mrs. Wood.

Engineers Corps Changes.—Capt. Lewis C. Overman, corps of engineers, will be relieved from duty under the immediate orders of Major Wm. R. King, and will, on or before November 1, 1882, relieve Major John M. Wilson of the charge of the improvement of the harbors at Port Clinton, Monroe, Toledo, Sandusky, Huron, Vermillion, mouth of Black River, Rocky River, Cleveland and Fairport, and of the improvement of Sandusky River and of water-level observations on Lake Erie, and survey or examination of Old River Bed, Cleveland, Ohio, taking station at Cleveland. Capt. Milton B. Adams, corps of engineers, will relieve Major John M. Wilson of the charge of the improvement of harbors at Ashtabula and Conneaut, Ohio, and Erie, Pennsylvania, and Major Walter McFarland of the charge of harbor improvement at Dunkirk, New York, taking station at Erie, Pennsylvania. Major Wilson, on being relieved by Capts. Overman and Adams, will report in person to the chief of engineers for duty in his office. These changes will take effect on or before Nov. 1, 1882. Major Franklin Harwood, corps of engineers, will be relieved of his present duties by Major Francis U. Farquhar, and will take station at Wareham, Massachusetts, relieving Major John W. Barlow of the temporary charge of the improvement of the harbors of Wareham and Hyannis, Massachusetts, and Col. George Thom of the charge of the harbors of Provincetown, Plymouth and Scituate, Massachusetts. Special order No. 147 is so modified as to direct Lieut.-Col. (then Major) Godfrey Weitzel to turn over the charge of the Louisville and Portland canal, and the improvement of the Falls of the Ohio River, to Major Wm. E. Merrill, instead of Major Francis U. Farquhar. By direction of the Secretary of War, so much of special field orders, No. 154, and so much of special orders, No. 318, series of 1862, department of the Mississippi, as relates to First Lieut. Samuel Winter, company A, 16 Missouri Volunteers, are revoked, and, to complete his record, he is honorably discharged, to date February 28, 1862, to which date he was last paid.

TRYING TO DETERMINE THE CENTER OF GRAVITY.

Montreal, September 7.—Professor Peirce, of Washington, is here taking observations for the American Government, to determine the center of gravity in Montreal, Washington and New York.

OPENING OF THE NEW ENGLAND MECHANICS' INSTITUTE.

ADDRESS BY EDWARD ATKINSON—AMERICANS LIVING ON AN AVERAGE OF FIFTY CENTS A DAY—WORDS OF ADVICE TO THE MANUFACTURER AND MECHANIC.

The second annual exhibition fair of the New England Manufacturers' and Mechanics' Institute was formally opened on the forenoon of the 6th, at the Exhibition Building, in Huntingdon avenue, Boston, in the presence of a large number of persons, embracing prominent members of the clergy, State and city officials, army and navy officers, etc. The opening ceremonies took place in the new music hall, constructed in the front gallery. The exercises began shortly after 11 o'clock, upon the arrival of Gov. Long and guests. The Rev. Brooks Hereford offered prayer, and President Little, in a few introductory remarks, introduced Gov. Long, who formally opened the exhibition.

Mr. Edward Atkinson, the speaker of the day, delivered a long address devoted to a review of the purposes and methods of the association. "It is a matter of necessity and always will be," he said, "that by far the larger part of the community—at least nine out of ten, probably more—shall earn their daily bread by their daily work. The true end to be sought, therefore, is to make that daily work less arduous. It is not of much consequence that dollars shall be more plenty if each dollar will buy more in this year than it did in the last. I shall presently prove to you that the measure of comfort which each man, woman and child can yet enjoy on the average, even in this prosperous land, must come within what half a dollar a day—possibly, not even probably, 60 cents will buy at present prices. Different economists have varied in the computation of the value of annual product in such measure that their estimates, applied to our present population, would range from seventy-five hundred to ten thousand million dollars. I have adopted the latter, which gives half a dollar a day to each man, woman and child. We now number about fifty-four millions, or we shall reach that number very soon. The following table will show how rapidly an addition of products to the value of five cents a day per capita increases the gross annual product:

At 35 cents per day our annual product is..	$ 6,898,500,000
At 40 cents per pay our annual product is...	7,884,000,000
At 45 cents per day our annual product is...	8,869,500,000
At 50 cents per day our annual product is ..	9,855,000,000
At 55 cents per day our annual product is...	10,840,500,000
At 60 cents per day our annual product is...	11,826,000,000
At 65 cents per day our annual product is ..	12,811,500,000
At 70 cents per day our annual product is...	13,707,000,000

Even the whole waste and cost of war must come from each year's product during the war itself, except such munitions as may be borrowed from other countries. Debt incurred for war merely defers payment. The first question of wages is a question of quantity: How much is there produced? The second question is the question of price: What is the product worth? The third question is the question of distribution: What share of the product at its price does the workman receive? The wages fund is not the quantity of things previously produced, but it is substantially the quantity produced at the time or in the year in which the work is done.

"Fifty cents a day is very surely the average measure of the subsistence, savings and taxes of each person. One dollar a day for each adult, $2 a day for each family group of two adults and two children, is the limit, because there is probably no more to buy. By so much as some of you enjoy more, others must have less. What have each of you done, what are you doing now, to entitle you to more than what half a dollar a day will pay for in food and fuel, shelter and clothing? Are you rendering service equivalent to your greater gain? Are you engaged in useful work by which the abundance of things is increased and the general struggle for life made easier? This measure of subsistence is, indeed, very limited; but only those can be permanently helped to enlarge it who can help themselves, and few have done more to establish the practical arts upon a scientific basis, by which abundance may be increased, than the men who remain in charge of this work and who control and direct the work of this association. The small minority of people who can become the possessors of capital in any large measure, even in this great and prosperous nation, must justify the leisure which they or their fathers have earned by the use which they make of the time and means at their disposal. The material welfare of the people depends not upon one but upon two factors, each the necessary complement of the other, an abundant production and a quick and equal distribution. Bad institutions, the unwarranted interference of statutes with individual rights, the abuse of the power of taxation, the waste of public money, the creation of a class of public spendthrifts who fatten upon the labor of a people under the forms of law, ignorance among great masses, and incapacity to adopt the new industrial methods which every day assumes new forms, may, even in this country as in all others, interfere with equitable distribution and promote scarcity. Witness the burden of the standing armies and of the privileges of the few in other countries, to which I shall presently call your attention more directly. True, we are free from these special evils, but let us ask ourselves how long can we bear without moral, mental, and material degradation the corruption of the civil service, the spoils system in politics, and the abuses of the power of taxation in cities, States, and nation which are not only a consequence, but a most potent case of civil service corruption?"

Continuing, Mr. Atkinson discussed the difficulties in the way of determining the measure of the country's annual product in terms of money, with reference to the proportion spent for subsistence. He inveighed strongly against waste among the people. "There is but one way," he said, "by which to make the struggle for life easier. That is through such instruction as will develop brain and hand together, so that the purchasing power of each dollar may be increased. Save the waste of labor and the waste of product. We are the most wasteful nation in the world; and one reason is, that, even at our present measure of product, there is vastly greater abundance here than there is anywhere else. "The speaker dwelt upon the value of economy in little things—by fractions. To intelligent action in this line he looked for the working of wonders.

Considering the subject in another light, he further said: "And now I beg to present to you a proposition which is very far-reaching, very subtle, and of very wide application, but which is seldom considered unless attention is almost forced to it. It is this: So long as freedom of contract is not restricted or obstructed by statute law, so long as laws are enacted only for the enforcement of justice and order, the prevention of crime, and punishment of fraud, and the accomplishment of purposes which cannot be worked by individuals, it will be found that high wages or earnings are almost the necessary correlative of low cost of production, and not, as is so commonly assumed, that low cost can only be compassed by way of low wages. This seems a paradox; yet it is elementary, and it is within the observation of every one of you here present; from your own experience you can prove or disprove this proposition. It simply needs to be borne in mind that the annual profits of capital and the annual wages of labor are both derived alike from the annual product. The more effective the capital in the form of machinery, the less the number of persons required, the higher the wages. The more skill on the part of the persons who operate the machinery, still again the less the number required and the higher the wages. The more effective the capital, the lesser the proportion which the capitalist will secure in order to make good interest upon his investment. The more adequate the skill, the larger proportion will the laborer attain. The more effective the application both of capital and of labor, the larger both the profit and the share of the laborer. And when this product is converted into terms of money, or what money will buy, the higher the price of wages and the lower the cost of production.

"It therefore follows that the rate of wages, or earnings of the masses of the people who are of necessity engaged in their daily work for their daily bread, will be high or low (always assuming an honest specie standard for the money in which the sum of wages is to be expressed).

"*First.* According to the conditions and resources of the country in which the labor is exerted.

"*Second.* According to the freedom of that country from statutes under which the liberty of the individual is restricted.

"*Third.* According to the freedom of that country from the imposition of taxes by which a large portion of the products of labor are diverted from the remuneration either of labor or capital, and are applied to what may be named (for the purposes of this consideration) destructive taxation.

"Of the first two conditions I need not speak at length, but I may call your attention to our paramount advantage in respect to the third. There are two kinds of work to which the proceeds of taxes are, or may be, applied:

"First, constructive work which the municipality, the State, or the nation can perform better than the individual, such as the making of common highways, the maintenance of common schools, the postal service, and some other simple functions distinct from the administration of justice or other administrative functions of government. In this country even the support of the army may be included in the constructive work of government, because it is our good fortune to need an army only to serve as a border police, and for the protection of settlers engaged in increasing the general product. But if we compare our condition with that of those States of Europe which are called civilized, we find a marked difference. In such States, for various reasons, a very large proportion of the annual product of labor is taken from the people in the form of taxes, and is applied either to sustain special privileges or merely to the destructive purposes of war."

In his closing sentences the speaker declared that the New England Manufacturers' and Mechanics' Institute was entering upon a field where a great work is to be found. The institution, he said, was at least certain to serve as an example which "must be followed in New England even if nowhere else." He added: "If we are to maintain our relative position in competition with our sister States, we can only do so by compensating for our lack of national resources by the perfection of our methods of instruction in the application of science to the useful arts. In sustaining these institutions you can justify yourselves for the possession of more than 50 cents a day for each member of your families by the investment which you make of your surplus wealth. To do unto others as you would be done by is to help others to help themselves. To give alms may be dangerous, and at best can only palliate the evils and wrongs of society. To relieve want by State charity may only promote pauperism. Yet give alms we must, and sustain charitable institutions we are compelled to, because we are subjected to the incoming of the poor and incapable of other lands. But from our children and our children's children, even unto the third and fourth generation, we may remove the doom of the ancient law, and we may assure them the reward of the faithful steward by developing hand and head together in their application to useful service."

NEW YORK WATER SUPPLY.

Considering the growing need in this city of a larger supply of water, the experience which the people of Boston have met with in supplying a similar want should not be without interest. When in 1846 the conduit was built from Boston to Lake Cochituate, a distance of about 18 miles, it was thought that the supply in the lake would be sufficient to meet the requirements of Boston until that city had a population of 800,000 souls. This calculation did not make sufficient account of the waste of water by its users, nor of the increase of the methods of using it. It became evident that when the city numbered only a little over 300,000 in population that an increase in the supply would be necessary, and the most economical way seemed to be to construct large storage basins in the valley of the Sudbury River, near Lake Cochituate, and build a new conduit to carry the water to Boston. Although this in itself was a new system, it was made by attachment to be practically an enlargement of the old system, for a great part of the Sudbury River water was sent through Lake Cochituate on its way to Boston, and both conduits emptied into the same reservoirs. The improvement involved an expenditure of nearly $5,000,000, and when it was completed the inhabitants of Boston congratulated themselves on the certainty of having all the water they wanted for a generation to come. But shortly after the new supply was put to use it was discovered that the water furnished to the citizens had a peculiarly unpleasant taste and smell. This soon passed off and then came again, and this process was repeated, the period of impurity each time increasing in duration. There have been any number of investigations made to determine the cause of this defect. Prof. Remsen, of Baltimore, is thought to have traced it to a sponge-like growth which he terms *Spongilla fluviatilis*, but neither he nor any one else has discovered the cause of its growth or how the water is to be purified. It seems highly probable that it came originally from the newly-made basins in the valley of the Sudbury River; but it has now infected the other ponds so that the entire supply is more or less tainted. The disadvantage of having the two systems together instead of wholly distinct is made obvious by this mishap, for if the two supplies had been kept separate, pure water would have been obtainable from one source. What the people of Boston will do it is not easy to say. A special commission is to be appointed to look into the matter, and its report will be awaited with much interest. The water, objectionable as it may be for drinking, is suitable for all other purposes. Spring water from hundreds of different places is now sent to Boston and is sold by the gallon for household use, and is retailed by the tumbler about the streets. It may be found necessary to provide an entirely new source of supply for drinking water, keeping the system wholly independent of the other water system.

THE GULF STREAM.

Commander Bartlett, of the English Coast Survey, has been investigating the Gulf Stream, and last week, at Montreal, he gave some of the results of his work. He made havoc among certain generally received ideas concerning that famous current, which, he says, does not flow out of the Gulf of Mexico, nor over a bottom channeled with ridges and valleys parallel with the Appalachian system. He says that there is a wide plateau extending along the coast from the Bermuda Banks, over which the Gulf Stream flows, sweeping it clean to its hard coral bottom. Beyond this, the bottom slopes rapidly downward, and is oozy with the wash from the plateau. The stream is not a river of warm water flowing over cold, and the Arctic current does not run inside. This will be all new to most people, and especially to those whose ideas of the Gulf Stream are indefinite any way. Perhaps a fact which will interest these people most in connection with the matter is the tribute Commander Bartlett paid to Yankee ingenuity at the meeting referred to above. A Dr. Carpenter having expressed his admiration of the work, added that it pleased him to know that the results were obtained with British instruments. To this Commander Bartlett replied that Sir William Thompson did invent an apparatus and kindly forwarded it to the Coast Survey, but it would not work. Yankee ingenuity then invented an attachment by which it was made so efficient that soundings of 3,000 fathoms can be made in 30 minutes, and without deflecting more than a fathom from the perpendicular.

KEELY MOTOR.

The directors of the Keely Motor Company held their regular monthly meeting on the 28th ult., and labored several hours with the great inventor in an effort to induce him to do something practical, instead of wasting further time in building engines to utilize the tremendous power which he claims to have discovered. There were present E. J. Randall, Vice-President of the Erie Railroad Company, who is President of the Keely concern; F. G. Green, Treasurer; C. A. Schuellermann, Secretary; W. W. Wright, a New York banker; C. B. Collier, of this city, and the inventor himself. It was impressed upon Mr. Keely forcibly that the directors desired him to at once take out patents for the "generator," which he admitted to be perfect, and let the engine building rest for the present. He was told that if the generator was what he claimed it to be, there would be no lack of inventors who would rush in and devise engines, which, however, could not be used until a royalty should be paid on the generating apparatus. Mr. Keely was finally persuaded to agree to file the necessary papers in the Patent Office as soon as they could be prepared, and the directors adjourned, professing to be perfectly satisfied.

Keely seems to have found a willing dupe in Mr. Boekel, who was appointed to become the custodian of the great secret, as Boekel reports to the court:

First.—That Mr. Keely has discovered a new force or motive power.

Second.—That the force or substance evolved by him through the instrumentality of his structure, designed by him under the varying nomenclature of vaporic force, etheric force and approximate designations, possesses properties peculiar to itself, and wholly phenomenal in character, differing essentially in many parts from those of compressed air or other gases, and requiring special machinery for its proper utilization.

All which nonsense is worth nothing compared to an answer to a question whether Keely took Boekel into the secret chamber, which no one but himself has yet entered, and showed him what it contained.

AMERICAN PUBLIC HEALTH ASSOCIATION.

SECRETARY'S OFFICE, 12 Pemberton Sq., }
BOSTON, Aug. 10, 1882. }

The American Public Health Association will hold its Tenth Annual Session at Indianapolis, Ind., commencing, Tuesday, Oct. 17, 1882, and ending Friday, Oct 20, 1882.

Papers will be presented on the Different Action of Disease in the White and Black Races, the Removal of Excreta, Heredity, Sanitary Associations, Vaccination, Intermittent Fever in New England, Sanitary Organization, Cattle Disease, etc., etc., with Reports of Committees on the Prevention of Venereal Disease, Compulsory Vaccination, the Management of Epidemics, Statistics, Cattle Diseases, National Museum of Hygiene, Incorporation of the Association and Necrology.

Terse, strong, practical papers on sanitary subjects are invited, and more time will be devoted to discussion than has been allotted at former meetings.

Papers offered to the Association become its exclusive property and are copyrighted.

Gentlemen who propose to present papers are respectfully requested to notify the Secretary at once of their intentions, and to give the titles of their papers, that they may be assigned place in the programme.

Present members of the Association are especially urged to every effort to increase its membership. Names proposed for membership should be sent to the Secretary.

Two proposed amendments to the constitution come up for action at this session.

It is expected that Vol. VII. of the transactions will be ready for distribution at or before the meeting.

Information in regard to transportation will be furnished by the Indianapolis Local Committee at an early date, and by a later bulletin from the Secretary, if required. By order of the Executive Committee. AZEL AMES, JR., Secretary.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

MEMBERS ELECTED JULY 5TH.

Peter C. Asserson, Civil Engineer, U. S. N., Norfolk, Va.

Edward Cook Burns, U. S. Ass't Engineer, Detroit, Mich.

David Dexter Clarke, Ass't Engineer, Northern Pacific R. R., New Tacoma, Washington Territory.

William Hooper Dennis, U. S. Coast and Geodetic Survey, Washington, D. C.

William Ludlow, Captain of Engineers, B'vt Lt. Col. U. S. A., Philadelphia, Pa.

M. William Mansfield, Engineer Maintenance of the Cincinnati and Muskingham Valley Div. P. C. and St. L. Rw'y, Zanesville, Ohio.

William Abbott Pratt, Engineer Ohio & Baltimore Short Line R'wy, Connellsville, Pa.

Nathaniel Chapin Ray, Ass't Engineer Union Pacific Rw'y, Sugar Loaf, Col.

William Starke Rosecrans, San Francisco, Cal.

William Harrison Smith, Res. Engineer New York, West Shore & Buffalo Rw'y, Oneida, N. Y.

JUNIORS.

Frederic Nicolas Blanc, Civil Engineer, New York city, N. Y.

MEMBERS ELECTED SEPTEMBER 6TH.

William Herbert Barker, Engineer on Atchison, Topeka & Santa Fe R. R., Las Vegas, N. M.

Richard Somers Hayes, Senior Vice-President Missouri Pacific Railway Co., St. Louis, Mo.

Horace E. Horton, Civil Engineer, Rochester, Minn.

Marsden Manson, U. S. Assistant Engineer, San Francisco, Cal.

Samuel H. Miller, Chief Engineer Chicago & Eastern Illinois R. R., Danville, Ill.

William Raymond Morley, Chief Engineer Sonora Railway, Hermosillo, Sonora, Mexico.

Arthur Bickley Paine, Chief Engineer Pennsylvania, Slatington & New England R. R., New York City, N. Y.

John Addison Partridge, Div. Engineer New York, West Shore & Buffalo R. R., Syracuse, N. Y.

James Ross, Gen. Superintendent and Chief Engineer Credit Valley R. R., Toronto, Canada.

Thomas William Seymour, 1st Lieutenant, Corps of Engineers, U. S. A., Washington, D. C.

FOR ASSOCIATES.

Paul S. Reeves, Proprietor Tubal Smelting Works, Philadelphia, Pa.

FOR JUNIORS.

George Edward Thackeray, U. S. Assistant Engineer, St. Joseph, Mo.

Albert Lowry Webster, U. S. Geological Survey, Washington, D. C.

RENTS AND WAGES OVER THE WORLD.

An Irish Farming Gazette recently gave some comparative figures on rents, leases, wages, etc., in the different modern countries, as follows: Rents per acre in Ireland, $3.50 to $5; in Great Britain, $9; in England, $11.50; in Belgium, $8; in France, $7; Prussia, $6 to $8; Austria, $5 to $6; Italy, Spain and Portugal, $5 to $6.

The wages of farm labor was in Ireland from 20 to 36 cents a day; in Scotland, 60 to 72; Belgium, 17 to 40; France, 28 to 40; Prussia, 27; Silesia, 12 to 20; Austria about 20; Italy, Spain and Portugal about 20.

The value of land per acre in Ireland was $150 to $225; Great Britain, $250 to $500; Belgium, $250 to $425; France, $200 to $300; Prussia, $200 to $300.

The fair production of wheat per acre was 26 bushels in Ireland, 28 in Great Britain, 21 in Belgium, 14 in France, 17 in Prussia, 10 in Siberia, 16 in Austria, 13 in Italy, Spain and Portugal.

The interest on farm mortgages was 4 to 5 per cent in Ireland, the same in Great Britain, 10 per cent in Belgium, France, Prussia and Austria, and 10 to 14 per cent in Italy, Spain and Portugal.

Compare these with some older figures.

D'Avenant, in his discourse on Trade (1698), says that the rental of England for land was £14,000,000, and in 1600 only £6,000,000.

Bishop Latimer, burned at the stake in 1555, said in a sermon that his father, about the time of the discovery of America, paid one shilling per acre rent for his land. It took seven years after marriage for a master tenant to acquire a flock bed and a pillow of a sack filled with chaff.

The monks, according to Evelyn, first began to drain the English land. The Saxons in the eleventh century recovered forty thousand acres from the sea at Romney.

The inclosing of commons, which began under Henry VIII., continued down to recent times, and between 1774 and 1813 there were 2,632 acts of inclosure passed for England and Wales. In 1750 there was a general act of inclosure passed for all Scotland.

All over Europe the priests indulge a secret hope of recovering their ecclesiastical lands, long ago confiscated.

VELOCITY OF LIGHT.

Important experiments are about to be made at the East End by Prof. Albert A. Michelson, under government auspices, to determine more accurately than ever before the velocity of light. Mr. Michelson is a young man who graduated from the Naval Academy at Annapolis, Md., in 1873. He came to Cleveland in May of this year, and is now connected with the Case School of Applied Sciences. After his graduation he remained at Naval Academy in Annapolis and undertook patient experiments to determine how fast light travels. The most accurate previous conclusions on this point were those of M. Cornu, made at the Observatory at Paris in 1874. The velocity of light, according to these experiments, was 300,400 kilometres, or nearly 186,584 miles per second. Mr. Michelson in his experiments in 1879 arrived at a velocity of 299,940 kilometres or 186,380 miles per second. While he was experimenting Prof. Simon Newcomb, of Washington, Superintendent of the Nautical Almanac, visited Annapolis, and interested himself in Mr. Michelson's operations. Mr. Newcomb did not believe the result obtained was as close as possible, and with Mr. Michelson's assistance undertook experiments of his own at Washington. He arrived at a conclusion slightly differing from Mr. Michelson's figures, but has not yet published the results he obtained. Later he repeated his opertions and obtained the same result as at first. He then asked Mr. Michelson to repeat his experiments. The latter has agreed to do so at Cleveland, and preparations for the work are almost complete.

The cost will be about $1,200, and will be borne by the Bache scientific fund. The site of the experiments is the grounds of the Case School at the East End. Here two buildings have been erected by Mr. E. P. Ingersoll, the well-known contractor and builder of Logan street. The larger building, 16 by 45 ft., contains a small engine and the chief apparatus. Two thousand feet west of it is a small building containing a stationary mirror. These buildings have been erected, and the apparatus will be ready for work in about two weeks. The machinery and manner of the experiment are quite complicated. In brief, however, a ray of sunlight is thrown upon a slowly revolving mirror, whence it is reflected upon the stationary mirror 2,000 ft. away, and from there reflected back over the same path. As the revolving mirror turns slowly the returning ray is moved slowly to one side. The velocity of the light is measured by a calculation of the various distances from mirrors to mirrors, angles, rapidity and distance of movement of the revolving mirror, distance of movement of the returned ray, etc. Prof. Michelson thinks that when he gets at work he can conclude his experiments and investigations in about three weeks. The work will be closely watched by scientists interested in that subject. The velocity of light has an important bearing upon astronomical calculations, and the experiment will be one of considerable value. Prof. Michelson, though a young man, has a reputation as a careful, reliable and conscientious investigator. His being placed in charge of the Department of Physics of Case School is evidence that he is an accomplished scientist.—*Cleveland Leader.*

SAN FRANCISCO'S STREETS.

Nothing could be more disgraceful to a great city like this, with a taxable property of $225,000,000, than the present miserable condition of its streets, unless it is the still worse condition of the sewers.

The picture is as bad as the worst enemy of the city could wish it to be. Hardly any of the principal business thoroughfares but Market street are decently paved. Uniformity has not been attempted. Some are represented in patches by cobblestone pavement, Belgian blocks, granite planking and common earth. Most of them are rutty, all are dirty, many are full of ugly holes, mud-puddles, and man-traps and horse-traps. On new and unaccepted streets, flanked by splendid residences, no work has been done for two years or more. The older streets have been torn up and disfigured by the gas company, and the Street Superintendent either has no power to compel their proper replacement or he wilfully neglects to do so. The general condition of the streets close to the water front, where they should be above criticism, because of the great use made of them, is indescribably wretched, dilapidated, filthy. Flood and fire combined could hardly have rendered some of them worse than they are and have been for several years.

We have said that the situation is as bad as possible. This should be qualified. It is as bad as possible for the dry season; but it will be much worse when the winter rains come; multiplying cesspools, deepening the mudholes and rendering many of the streets absolutely impassable for anything on wheels. It is worth while, also, in considering the subject of street improvement, to note that the system of sweeping our streets is abominable. It is sweeping without cleansing and removing the collected filth. Market street is swept every day, but every evening from 2 to 7 o'clock, when it is most used by the pedestrian class, it is the dirtiest thoroughfare in the city. The sweepings, ground into fine particles, saturated with all unclean and unhealthy things, sometimes including the glanderous droppings of diseased horses, as infectious as the small-pox or leprosy, are scattered by the west wind over all the pavements, inhaled in the nostrils, eyes, throats of everybody on the street, not merely to their great discomfort, but to the constant peril of their health. Science has recently proclaimed the fact that the expectorations of persons afflicted with tuberculosis, inhaled into the lungs of any healthy person, will breed tubercles, and cause consumption, asthma, bronchitis, catarrh. If this be so, it is no wonder, considering the slovenly mode of sweeping our streets, that the weekly bills of mortality show so large an account of deaths from these causes.—*Chronicle, Aug.* 17.

CITY IMPROVEMENTS AND MALARIA.

The very remarkable increase of malarial disease in the down-town sections of this City, which has followed directly on the prosecution of the excavation of the streets for steam pipes and electric mains, ought to lead sanitary engineers and scientific investigators to a thorough and exhaustive study of the conditions that govern the origin and development of malarial disorders. It has long been suspected by the most acute observers that there is an intimate relation between the development of malarial diseases and the setting free of the carbonic acid in the soil; in other words, that intermittent fever and kindred complaints are only another name for slow carbonic oxide poisoning, and that the hypothesis of malarial germs is a purely fanciful mode of accounting for the phenomena associated with these diseases. Some recent microscopic studies of malarial fever have clearly shown that the progressive destruction of the colored corpuscles of the blood is one of the principal physiological facts associated with the paroxysm, and as this phenomenon is one common to the action of all narcotic poisons, such as opium, tobacco, &c., it forms one of the links connecting malarial troubles with diseases arising from the use of narcotic agents. Moreover, in the later stages of the opium habit, regular and periodical paroxysms of intermittent fever form one of the series of symptoms that announce impending dissolution, and in the tobacco habit, when carried to an excess that impairs the constitution, such paroxysms regularly precede the onset of paralysis. It is a curious fact, also, to be noted in this connection, that carbonic acid in small doses, long continued, produces a type of periodical fever that can scarcely be distinguished from legitimate malarial disease. Facts like these, conjoined to the knowledge that carbonic acid is a narcotic poison of the most silent and insidious kind, have led some of our most prominent medical men of late to suspect that investigation as respects the etiology of malarial disease has been misdirected for many years, and to advocate a complete and thorough re-examination of the whole subject, with a view to settle the question of in how far the constant presence of a small admixture of carbonic acid gas in the atmosphere, brought about by excavations like those now in progress in the lower part of the city, by the decomposition of vegetable matter, or by other causes, may be instrumental in the production of a group of diseases hitherto ascribed to the operation of germinal matter floating in the air.—*N. Y. Times.*

EGYPTIAN STATISTICS.

ON December 31, 1878, the distribution of the population of Egypt was, at Cairo, 327,462; Alexandria, 165,752; Damietta, 32,730; Rosetta, 16,243; Suez, 11,327; Port Said, 4,854; other towns, 11,747; provinces, 4,948,512; making a total of 5,517,627.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

SCARCITY OF WATER.—Water is scarce at Marblehead Neck, Mass., and some families are paying 60c. per barrel for the liquid. Other families have cisterns filled of 16,000 to 20,000 gallons capacity.

LOW WATER.—The New Haven Water Company reports Lake Whitney lower than it has been for eleven years. New Haven uses 7,000,000 gallons daily, and its people are cautioned to economize. A main is being laid to draw from Lake Saltonstall.

EXTENSION IN PITTSFIELD, MASS.—A new 4-in. water main is being laid on Onota st., from Linden to West, and the trenches for a part of the way require blasting through the rocks.

ESTIMATE FOR WATER-WORKS.—The Council of Almonte, Ont., have engaged Mr. Keefer, Civil Engineer, at a cost of $500, to prepare an estimate of water-works. At the same time a by-law is in print, asking for money for a steamer.

WATER RATES IN PITTSFIELD, MASS.—The new water rates adopted by the fire district and the commissioners have been published. The principal changes are: Water-closets, not approved by the commissioners and without automatic arrangement for shutting off, $12.50, instead of $3.50 a year; hose for cleaning carriages, $18.75, instead of $3.50; metred water for six months, 12½ cents a thousand for the first 50,000 gallons, 10 cents for the next 100,000, 7½ for the next 500,000 and all in excess of that 6¼ per each 1,000.

WATER IN EGYPT.—A large supply of fresh water has been discovered at Alexandra in some old forgotten wells.

PLANKINGTON, Dakota, will bore for artesian water.

HOLYOKE, Mass., manufacturers are allowed only their minimum rates of water, the Water Power Company permitting no excess, as usual. Low water is the trouble.

THE Philadelphia Council has appropriated from the surplus fund $250,000 for the completion of a section of the East Park reservoir.

NORTHAMPTON, MASS., contemplates increasing its water supply from a little pond about two miles above Leeds. It is fed by springs of pure water and has no apparent outlet. It holds about 9,000,000 gallons of water, or a third more than the town reservoir, and it would cost but a trifle to add it to the town's supply. It has been called "Hanging mountain pond," though not near that mountain. Should the board be able to purchase the pond at a fair price, the question of a water supply in times of drouth may be simplified.

THE WATER COMMISSIONERS OF BOSTON announce that there is not more than 40 days' supply of water on hand, and talk of shutting down on lawn sprinklers.

THE RESERVOIR at Greenfield, Mass., holds a month's supply.

WATER IS SO SCARCE in some of the towns on the North Shore that Boston families located in cottages are sending their servants to Boston to do washing in their city residences.—*Exchange.*

THE CURTIS REGULATOR COMPANY.—The Locke Regulator Company has been merged in the Curtis Regulator Company, of 59 Beverly street, Boston, Mass. The latter company will continue the manufacture of the Locke regulator.

THE water supply for the first district of North Adams, Mass., owing to the increase in population, and the limited supply which the district controls, is too small, and N. W. Greene has presented to the prudential committee a plan to provide for future wants by sinking a gang of driven wells, and connecting them so that, by a pump, connection may be made with the street mains. He guarantees all expenses and a satisfactory supply.

GAS vs. ELECTRICITY.—Dr. Siemens, in a recent address before the British Association, said that the gas companies could afford to view the new light with equanimity, inasmuch as their by-products are worth £3,000,000 per annum more than the cost of the coal from which they are made.

ELECTRICITY.

THE Philipsburg Electric Light Company, of Philipsburg, Pa., was chartered last Tuesday. Capital, $8,000.

THE TELEPHONE IN NEW ENGLAND.—The newly organized Bay State telephone company is surveying for a direct and independent line from Boston to Framingham, which will be equipped with No. 4 wire, the largest ever used in the business. The object is to overcome the resistance heretofore so troublesome on long routes. This line will cost double that of the ordinary kind, and will connect with the new line already built between Worcester and South Framingham. A Worcester telephone force has also been engaged to put up a line between Worcester and Boston. The company propose to have a wire from Worcester to Providence this fall and make other extensions if practicable. The new line between Boston and Framingham will probably be in working order October 1. The syndicate of men living in Boston and Framingham, who have bought the Western Massachusetts company's lines, propose to increase its capital to $80,000.

ELECTRIC LIGHT IN WISCONSIN.—Three of the electric towers are completed in Fond du Lac, and the Mayor promises to have the city lighted by this means on Monday night next, at the outside. It was intended to put up five towers, but the engine-houses on which two of them were to be placed are found to be too weak. They will go up, however, in the near future if the light proves a success.

THE Pottstown (Pa.) Iron Co. are preparing to light their works, inside and out, by electricity, the Edison lights being selected for the purpose.

AN ELECTRIC RAILWAY FOR THE SWISS.—GENEVA, Sept. 4.—A syndicate of London capitalists have entered into a contract for the construction of an electric railway, upon the Edison system, between Geneva and Fernex and Geneva and St. Julien.

ERIE, Pa., is soon to have electric lights.

USE OF THE ELECTRIC LIGHT IN WAR.—The use of the electric light in warfare seems not as yet to be thoroughly perfected. An experiment was made with it the other night by the Superb, now lying off Ramleh, but, in the cautious language of the *Times'* correspondent, whether it was an advantage or otherwise is an open question. Inasmuch as the officer in charge of the picket, whose duties it was supposed to assist, complained that it was generally on his own men that the light was thrown, while all around them was wrapped in more than Egyptian darkness. It seems rather as though on that occasion, at least, it was very much otherwise. Indeed, one feels inclined to say of it much what Sam Weller said of the dark lantern with which Mr. Pickwick proposed to guard from discovery the midnight loves of Mr. Winkle and Miss Allen: "Wery nice things, if they're managed properly: but when you don't want to be seen, I think they're more useful after the candle's gone out than when it's light."

STREETS, DRAINAGE, ETC.

COUNCILMEN INSPECTING THE STREETS.—Councilmen of Philadelphia, composing the highway committee, recently inspected certain streets, and found that the contractors had neglected their work on several.

OSHKOSH, Wis., wants its streets systematically numbered.

IT is said that twenty miles of new pavement are being laid in Atlanta, Ga.

RIVERS AND HARBORS.

THE DELAWARE BAY LIGHTHOUSE.—The Lighthouse Board has made its report to the Secretary of the Treasury of the operations of the lighthouse service for the fiscal year ended June 30, 1882. An appropriation of $75,000 is recommended for the completion of the lighthouse in Delaware Bay to take the place of the fourteen-feet-bank lightship.

THE POTOMAC RIVER IMPROVEMENT.—Major Hains, the U. S. Engineer in charge of the Potomac river improvement, is busy with his plans and will commence operations as soon as possible.

A NORTHERN WATERWAY.—The project of the Hudson's Bay Company in putting a steamboat on the Athabasca River is a movement that promises the most important results to that far-off country, and is one of the most daring of the many flights of enterprise that have marked the opening up of the northwest, and much greater than their other act of building a tramway around Grand Rapids and putting steamers on the Saskatchewan. When a railway is built across an unopened country, a line of settlement is sure to follow, and to contribute largely to furnishing traffic for it; but this case is widely different, for its mission will be to open up a country at present unsettled by any save the employés of the Hudson's Bay Company, some missionaries, a few traders, and a mere handful of men who have gone in this season to test the agricultural capabilities of the country to which the Athabasca affords the readiest access, and which is reported as being equal in fertility to any part of the continent. The steamer in question is no mere toy affair, but will be worthy of the noble stream it is to ply upon. It will be provided with powerful machinery of the most modern character, only equaled by that of the new steamer now being placed on the Saskatchewan. Few people can form an adequate conception of the difficulties to be overcome in taking the ponderous machinery overland to its destination, nor the amount of labor that will be involved in getting the necessary timber and material ready in these remote regions, where everything is done by hand, and where skilled workmen of the various classes necessary to construct the vessels must all be taken in by the company. Captain Smith, so favorably known on the Saskatchewan, will probably be sent north to superintend the construction of the new vessel. The machinery, etc., were taken to Carlton a short time ago, and dispatched to their destination by the company's ordinary route. The successful working of this boat will give an impetus to travel and trade that will soon make the present organized territories, with their lines of steamers and railways, seem to be among the central if not the eastern territories. This boat will be the pioneer in opening up a system of magnificent water-stretches far grander and of greater extent than the famed St. Lawrence system.—*Saskatchewan Herald.*

RAILROADS.

THE Atchison Company has completed its purchase of the Leavenworth, Topeka & Southwestern Railway. It is understood that the Atchison had to compete with the Rock Island for the purchase of this promising rival, and there is also reason to believe that the Union Pacific is associated with the Atchison in this matter, the object being to secure possession of the railway system of Kansas.

NEW YORK, WEST SHORE & BUFFALO.—One of the most important railway enterprises of the country under process of construction is that of the New York, West Shore & Buffalo Company, which is at work upon a double-track road of the best construction between New York City and Buffalo via Schenectady, Rochester, etc. This road is being constructed by the North River Construction Company, the President of which gives the following account of the present status of the Construction Company and the railroad. The authorized capital is 100,000 shares, valued nominally at $10,000,000. The receipts to date from bond subscriptions, stock, etc., $12,849,184.40. The disbursements are $12,088,511.79, having cash assets of $760,672.61. Other resources are West Shore bonds, less subscriptions paid, $9,701,500; balance due on construction company stock, $4,008,900; total resources, $14,472,072.61. Deduct bond subscriptions that may not be collected ($2,675,000) and liabilities (228,450) and there remains available cash assets of $11,568,622.61. The estimated cost of the completed road from Cornwall to Albany and to the Oswego Canal, in Syracuse, is $18,794,279, of which there has already been paid $9,882,916, leaving yet to be paid to complete the roadway, track, superstructure, buildings, and for all other matters, to Albany and Syracuse, $8,911,363. After completing the road to Syracuse there will be in the treasury of the company a surplus of $2,657,260 to be applied on equipment and for construction west of Syracuse. The total cost of the road from Cornwall to Buffalo (double track), a distance of 373 miles, with a single track branch to Albany (13 miles), is estimated at $30,100,000, or, including the cost of equipment, $34,160,000. Of this amount there has already been expended the sum of $11,109,839. Balance required to be spent to finish and equip to Buffalo, $23,050,161. The present available cash resources of the Construction Company applicable to this work are, as before stated, $11,568,622, leaving a balance of $11,481,538 which will still be required in order to complete and equip the whole road. To provide this $11,481,538 the Construction Company will control about $26,000,000 of West Shore first-mortgage bonds and $30,000,000 of its stock. The surplus from said securities will be for account of the stockholders of the Construction Company. The total amount expended to date on the construction of the West Shore & Buffalo road is $17,609,839. It is expected that cars will be running between New York and Albany by Jan. 1, 1882, and to Buffalo Jan. 1, 1883.

TWENTY NEW railroads are said to be in process of construction in Florida.

EARNINGS OF THE D. R. G. R. R.—The following circular has been issued by the president to the stockholders: The gross earnings of the Denver & Rio Grande Railway (construction material being deducted) for the years 1881 and 1882, so far as reported, present the following comparisons: The gross earnings for the month of July, 1882, declined four (4) per cent. on the same earnings for July, 1881. The gross earnings for the month of August, 1882, declined one (1) per cent. from those of August, 1881. The gross earnings for the first seven (7) months of 1882, gained over fifteen (15) per cent. over the same earnings for the first seven (7) months of 1881.

THE MEXICAN NATIONAL.—A dispatch from Monterey, Mexico, Sept. 1, says: "The first passenger train on the Mexican National Railroad entered this city last evening. The road is now completed from Corpus Christi, Texas, to this point, a distance of 330 miles. The opening of this line makes Monterey the great gateway to Mexico from the United States. The inhabitants are wild with delight, and visitors are received with the most enthusiastic acclamations, thousands blocking the railroad station to witness the arrival of the iron horse. The track is being vigorously pushed toward Saltillo, 70 miles south; also from the city of Mexico to Acambaro, which place, it is hoped, will be reached in December. The intervening gap, from Saltillo to Acambaro, 490 miles, has been provided for by a London subscription, and efforts are being made looking to its completion by next summer. This will place through rail connection with the city of Mexico from New York City."

"CITY OF MEXICO, Sept. 2.—The government engineers having reported that the Toluca division of the Mexican National Railroad is solidly built, it will be opened to Traffic next Monday. To-day the company gave an excursion to Toluca, which was attended by cabinet ministers, congressmen and many other distinguished persons.

R. R. STATISTICS.—Railway building in the United States has proceeded during the last month with extraordinary vigor. The following table shows the number of miles of main track—not including side track or additional tracks—laid during the month of August:

States.	Lines.	Miles.	States.	Lines.	Miles.
Arizona	1	11.50	Michigan	1	10.00
Arkansas	1	20.00	Minnesota	2	27.85
California	3	51.50	Mississippi	1	10.00
Connecticut	1	1.00	Missouri	1	30.00
Dakota	3	57.98	Montana	2	29.00
Florida	1	8.00	Nebraska	2	37.00
Idaho	2	62.00	New Jersey	1	5.00
Indian Territory	1	14.00	New York	6	153.00
Illinois	4	54.30	North Carolina	1	11.00
Indiana	2	40.00	Ohio	5	45.24
Iowa	6	267.00	Oregon	2	21.50
Kansas	2	22.00	Pennsylvania	4	71.00
Kentucky	1	8.50	Tennessee	1	7.00
Maine	2	12.50	Texas	4	65.50
Maryland	1	5.00	Virginia	2	21.00
Massachusetts	1	2.50	Wisconsin	3	142.70
Totals, 32 States				70	1,274.15
Total, Jan. 1 to Aug. 31					7,048.02

The month of August has also been notable as witnessing the practical completion of two important East and West lines—the New York, Chicago and St. Louis Railway, 528 miles long, and the New York, Lackawanna and Western Railway, over 200 miles. Great progress has also been made on another competing line to the East, the Chicago and Atlantic—upon which the track is now about one-half laid—and on other important lines, such as the Northern Pacific, Atlantic and Pacific, Southern Pacific, California Southern and several other great roads.

A PENNA. ROAD CHARTERED.—On the 6th a charter was issued to the Swatara Railroad Company, which proposes the construction of a 3-mile line, connecting with the Philadelphia and Reading at Steelton. The capital stock is $30,000. The corporators are L. S. Bent, Steelton; Lyman D. Gilbert, Harrisburg, and D. F. Barker, Philadelphia.

THE UNION PACIFIC owns and operates 3,774 miles of road and, besides, owns a controlling interest in the Utah Central (280 miles), Nevada Central (93 miles), Central Branch (386 miles), and will soon have completed the Oregon Short line (600 miles), making a grand total of 5,133 in the Union Pacific system. Nor is the work of extension yet finished. The Denver & South Park line is being built into the Gunnison district of Colorado in search of coal, and it is hinted that this line may be continued to Salt Lake if rival roads force the Union Pacific to take the step of self-defense. It is intimated that a road from 'Frisco, Utah, the terminus of the Utah Central, may be built to the Pacific if necessary. The earnings grow more and more satisfactory. The earnings for August are reported at $2,702,107, an increase over last year of $123,448.

THE NEW YORK, CHICAGO & ST. LOUIS ROAD.—Brown, Howard & Co., the contractors for the New York, Chicago & St. Louis Road, have formally announced the completion of their contract. The road has been finished between Chicago and Buffalo and turned over to the railroad company, which has also announced the fact that they take formal possession of the property. Until further orders all employés will continue in their present positions under the direction of Engineer Latcha, of the "Nickel Plate," who has charge of construction.

THE CHICAGO AND ATLANTIC RAILROAD has just been completed. The road extends from Marion, O., where it connects with the New York, Pennsylvania and Ohio, to Chicago, and is 257 miles in length, and will have fifty miles of siding. The average cost of the road-bed is about $30,000 per mile, and the total cost of the road will be about $8,000,000. The capital stock is $10,000,000. The road traverses a rich agricultural country, and about forty depots will be located on the line. The present equipment consists of 300 flat cars, 200 box cars, and twenty four engines, but large orders are still unfilled, and the completed equipments will be as fine as that of any road in the country. The road-bed is laid with sixty-pound rails, which cost about $58 per ton on the ground. It is the intention to open the road for business about October 1.

THE Mexican National Construction Co., 47 William street, state the following: The track of the Mexican National Railway reached Monterey Sept. 1, three hundred and thirty-three (333) miles from Corpus Christi. Including this, the company have already five hundred and twenty (520) miles finished in Mexico and Texas, and will probably have six hundred (600) in October. Monterey is about five hundred (500) miles from Maravatio, which the track is promised to reach from the City of Mexico next month. Over nine hundred (900) miles have been subscribed for.

CANALS.

CANADA'S NEW CANAL.—TRENTON, Ont., Aug. 31.—The first sod of the Murray Canal was turned to-day with appropriate ceremonies. The canal connects the head waters of the Bay of Quinte with Lake Ontario, and will be completed in three years.

THE PANAMA CANAL.—A Panama despatch says: All the heavy work on the Interoceanic Canal is to be stopped. The rainy season so far has been a very light one, yet it is found that even a slight rainfall impedes all work and in low ground entirely prevents its being carried on. The men who attempt to work fall sick and the men in charge of gangs of laborers say that none of them can work more than three days a week, the remainder being passed in bed with fever.

CONTRACTS LET.

GRANITE CURB CONTRACT LET.—WASHINGTON, Sept. 6.—L. S. Filbert, of Philadelphia, has been awarded the contract for the granite curb and granolithic pavement for approaches to the Government Building at Philadelphia at his bid of $9,560.

BIDS FOR HEATING APPARATUS AND JOINER'S WORK.—Bids were opened at the Treasury Department for heating apparatus for the Albany Custom House. Frederic Tuder was the lowest bidder, at $19,423, and will probably get the contract. Bids were also opened for joiner's work on the Danville (Va.) court house, the lowest bid for which was Robert Davidson, of this city, $10,708.

CITY HALL CONTRACT LET.—Pueblo, Colorado, has contracted for a new city hall to cost $10,894.

COURT-HOUSE CONTRACT LET.—A new contract has been let to complete the court-house at Escanaba, Mich., and the work is again progressing.

BUILDING.

A LARGE shingle mill is to be built at Muskegon, Mich.

A NEW FERRY HOUSE IN THIS CITY.—Laborers are now engaged tearing down the old ferry-house at the foot of Wall street, to make room for the more modern structure about to be erected by the Union Ferry Company. The new ferry-house will be similar to the one at the foot of Montague street, Brooklyn. The building will have a frontage of 125 ft., it will be 150 ft. deep, and its extreme height will be 70 ft. It will be finished in hard wood and gilt and will be of more elaborate workmanship than the one in Brooklyn. Mr. George Wright, the Superintendent of the Union Ferry Company, hopes to have the building completed in three months.

THE NEW EDDYSTONE LIGHTHOUSE is built of 2,171 stones, containing 63,022 cubic ft. or 4,668 tons of masonry. The amount of stone contained in the tower of the old lighthouse was only 988 tons. It is believed that the sheer weight of the new tower will enable it to withstand a considerable force of wind or wave. Every stone is dovetailed above, below and on all sides, and the work is cemented. Up to a height of 25½ ft. above the level of high water the tower is solid, with the exception of a space given to a large water tank.

OPERA-HOUSE.—Bethlehem, Pa., is to have a $30,000 Opera-house.

LABOR.

WAGES IN FLORIDA.—The prices for labor on the Cumberland Sound and also on the St. John's jetties, Fla., were for the last six months $1.25 to $1.75 per day for negro workmen and white laborers, the highest price being paid to the latter and to sailors on the stone boats. Mat builders received $2 to $3.50 per day, the latter price to bosses. Jack carpenters $60 and $75 per month, days of ten hours; $3 a night each man was paid for night work.

BOSTON'S 40 stone-cutters working on the new system of sewerage work nine hours a day, and demand that their wages be raised to $3.

BRIDGES.

THE RIVER PO, between Pavia and the sea, was never bridged by the Romans, but within twenty years four bridges have been built over it. These bridges are 1,900, 2,600, 1,309 and 1,312 ft. long respectively, and are all iron girder bridges.

BRIDGE CHARTER GRANTED.—A Charter was issued last Tuesday for the McKeesport & Youghiogheny Bridge Company, Pa., for a bridge at Youghiogheny. Capital, $60,000.

BUILDING A MASS. BRIDGE.—The New London Northern Railroad Company is driving piles at the "spile" bridge in Amherst for a foundation for a permanent bridge to take the place of the trestle-work.

ENGINEERS AND ENGINEERING IN OTHER LANDS.

[Specially translated and prepared for the ENGINEERING NEWS.]

The extraordinary growth of the port of Libau, is due to various causes. The Russian Government is averse to having the great wheat trade of Eastern Russia seek Kœnigsberg and Stettin, especially since the protective tariff of Germany went into operation. The town itself has about 16,000 inhabitants, and lies in a neck of land about 1,900 yards in length. The harbor itself extends parallel to the Baltic some ten miles, and is nearly 1½ miles in width. It communicates with the Baltic by means of a channel. The pool of Libau is also in connection with the pool of Tosman, which is parallel to the sea bank. The river is very insignificant, and does not bring any detritus down to the channel. The harbor works have been going on for years, but new plans are now to be executed. The width of the port is some 120 feet, and the depth at average water some 16 feet. The channel was formed by pile planks. Two rows of piles were first driven down and then sawed across at low water level; caissons filled with gravel and clay were then placed on top. The entire wall thus made was protected by a number of posts joined together by longitudinal sleepers. This work, strengthened by wooden braces, was not water-tight, and it broke down in several places. The jetties which are in the open sea are laid on caissons filled with stone or on enrockments.

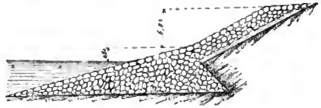


FIG. 1. STRENGTHENING THE SEA BANKS TOWARDS THE WEST.

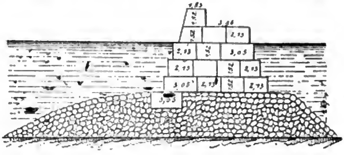


FIG. 2. SECTION OF BREAKWATER.

The Russian government has resolved to have several improvements made: the deepening of the roadstead to 7.82 met., at entry; to have new quay walls; new basins; prolongation of the south jetty, and to have two breakwaters with two passages of 15.24 m. each. The object of these breakwaters is to create a maritime current that will be sufficiently powerful to prevent the formation of a bar, and to protect the entrance of the port so as to dredge.

Fig. 1 shows an enrockment which is to be made so as to strengthen the western bank. Fig. 2 and 3 are cross sections of the proposed breakwater. Curiously enough, however, the good citizens of Libau have so energetically protested against building these breakwaters that the government hesitates. The objection is that, by weakening the movements of the tides in the port, these breakwaters will facilitate the formation of ice in the basins in the winter, and freeze up Libau.

Despite the prohibition issued, the works on the great tunnel between England and France are still progressing. If this work be carried out, it will certainly rank as the greatest engineering undertaking that the world has ever seen; for, accustomed as we are to wonders in these days, few will believe in the practicability of such a road. Some 3,000 specimens of the bottom and lower strata have been examined. Chalk is, as might be expected, the principal substance. Between the upper chalk and the gault is a thick bank of gray chalk, which is impermeable. Here and there, however, there are springs of fresh water. Two wells have been sunk, and a gallery at a slight incline, and almost in the vertical plane of the proposed tunnel, has been made. The geological formation is rather simple, alternate marls and chalk, composed of fossils of various kinds.

The following data are common to the two wells:

	Metres.
Altitude of the orifice with relation to the hydrographic zero	30.80
Static level of running waters at 23.83 m. depth, or	6.97
Average static level is at 24.50 m. depth, or	8.30
The Bourdaloue level is at 27.633 m. depth, or	3.17

Greenish chalk was met with to the depth of 21.78, met. with very hard nodules; at this latter depth the chalk termed "Rouen" was come across, and its base was at 90.20 m. The shafts are timbered, so that the thickness increases with the depth.

Quite a large amount of machinery is established on the French side, and everything completed for the boring machines, which are now being put up; the Beaumont machine being now employed on gallery No. 1, working on a diameter of 2.13 m., and at 55.20 m. below low water. The Brunton machine will begin at 73 m. in the well. These machines will work without the use of explosives, and the rocky part will be taken out in small pieces. The Beaumont machine that has been built for the French company is to work at double speed.

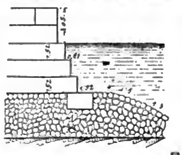


FIG. 3. SECTION OF BREAKWATER.

An Austrian patent for an explosive, which is said to offer less danger than others in use has just expired. It was taken out only a year ago by Koeppel. The inventor claimed for it that it is cheaper than any other, gives no injurious smoke or gases, and does not explode from concussion or friction. It is manufactured in two kinds, of which the following is the composition. No. 1 is specially adapted for hard rocks, basalt, etc.; and No. 2 for sandstone, lime, etc.

	No. 1. Parts.	No. 2. Parts.
Saltpeter	35	42
Soda	19	22
Refined sulphur	11	12 50
Sawdust	9 50	19 00
Chlorate of potash	9.50	......
Charcoal	6	7
Sulphate of soda	4.25	6
Prussiate of potash	2.25	.....
Refined sugar	2.25	......
Picrin acid	1.25	1.50
	100	100

Each ingredient is finely pulverized and passed through a sieve, then mixed in a mixing cylinder of copper or wood, until the sawdust is hardly noticeable. From 10 to 15 per cent of water is then added, and the whole stirred until large pieces are formed.

RECENT INVENTIONS PATENTED DURING THE PRESENT WEEK.

EXCAVATING MACHINE.

This improvement consists of a wheeled frame carrying a lower skeleton drum, and which is provided by cutting and shaping arms connected to the axles and the rims, and on each end of the axle with small bent knives. The knives are fastened to the buckets at the outer central point. A horizontal cylindrical receptacle having a rotary bottom and revolving 8-shaped arms receives the earth from the buckets, which is then thrown out of the opening in the sides of the receptacles by centrifugal force. The machine is driven by steam power located on the frame.

VARIABLE SELF-ADJUSTING ENGINE.

This novel engine is of the double cylinder type, with the cylinders arranged at an angle of 45° from each other. In combination with each cylinder is an unattached auxiliary piston-head or follower, having valves with projecting stems, whereby the pressure on opposite sides of the auxiliary head is equalized, and the length of the piston stroke automatically changed or adjusted to the throw of a variable crank; that is, a portion of the imprisoned steam is permitted to escape when it comes in contact with the cylinder-head, and increased length of piston stroke obtained.

NEW FIRE ESCAPE.

In this improvement one end of such of a series of vertical ladders is fastened to a folding frame, and the other end to a small platform over the opening in the main platform. A pawl secured to a knee lever engages with a ratchet wheel on the roll, on which the ropes for folding and unfolding the frame are wound. Pulling on side ropes which are attached to the knee-lever, releases the pawl from the ratchet and allows the frame to be folded and unfolded. When folded the frame is flat against the building.

RAILWAY-RAIL GUARD.

A recent invention provides a metallic guard consisting of an upright shield having a flanging base, the ends being bent inward and adapted to fit between the upper edge of the rails and its projecting base, and is held in place by engaging the flange under the spikes.

GAS ENGINE.

A late English invention has been constructed, having a power or explosion cylinder and a cylinder for preparing and compressing the charge for the explosion cylinder. It is also provided with an exhaust valve. The cranks of the two pistons, and the valve which regulates the transfer of the charge from the compression cylinder direct to the power cylinder are arranged relatively to each other and to the exhaust valve, so that the latter remains open during about the first nine-tenths of the return stroke of the power piston, and then closes. The charging of the power cylinder with the compressed gaseous mixture is then effected during about the last one-tenth part of the said return stroke of the power piston and about the one-tenth first part of the outward stroke of this piston, at which point of stroke the explosion takes place.

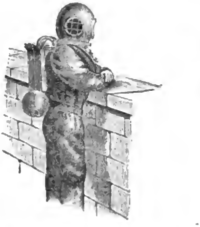
RAILWAY CROSSING ALARM AND SIGNAL.

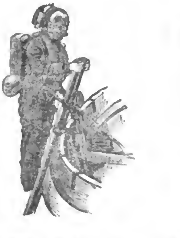
In this invention the end of a tread lever works in a notch in the track rails, its outer end supporting a rod which operates a bell crank, to which is secured the signal connection. The treadle is carried into or out of operative position through a sliding wedge piece actuated by the passing wheels through rock shafts connected thereto.

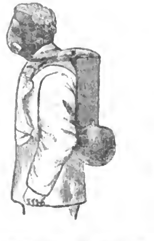
WASHINGTON, D. C. F. B. BROCK.

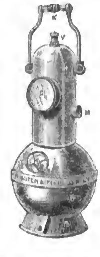
* * *

THE FLEUSS PATENT BREATHER FOR WATER, NOXIOUS GASES, OR SMOKE.









The record of the earlier attempts to provide some artificial supply of air to divers under water is very unsatisfactory. The invention of the diving bell is generally assigned to the sixteenth century, but not till the year 1779 was it practically employed in civil engineering operations. In that year Smeaton used it in repairing a bridge at Hexham, Northumberland, England.

In 1828 Mr. Siebe, of the now well-known firm of Siebe, Gorman & Co., invented what was called the Open Diving dress, in which the air escaped into the water from underneath the outer canvass jacket and the water reached within a few inches of the diver's mouth, so that he had to work in a vertical position, the air being supplied from air pumps with three cylinders 3 in. diameter and 9 in. stroke.

About 1839 Mr Siebe, observing the danger attending the use of the open dress, introduced his invention of the close dress and helmet, which is the present form of diving dress used.

In 1880 Mr. Fleuss conceived the idea of dispensing with the Air pump and Air-conducting pipe, and invented an apparatus worn in the form of a knapsack which contains a filter for purifying the breath; that is, absorbing all the carbonic acid which is given off at each expiration, and mixing the nitrogen, which is retained and used over again with the necessary amount of oxygen, the oxygen being carried in a cylinder at the bottom of the knapsack,. in a valve attached, so as to be used easily by the diver, who administers the oxygen as he requires it. In this dress the diver has his life entirely in his own hands, everything being at his command, and he is in no fear of those pumping air to him (as in the ordinary dress used) going to sleep or stopping to fight—cases that have actually occurred, resulting in the diver losing his life, and it will be readily understood that under many circumstances the power of dispensing with the air tubing is of exceptional value in diving operations. To mention one instance where the value of this apparatus is shown: in the Severn Tunnel Works being constructed for a railway between Bristol and South Wales, a heading had been driven under the bed of the river from the shaft on shore. At about a quarter of a mile from the shaft in this heading was an iron door which, after the works had been accidentally flooded, it was essential to shut before pumping out the water could be accomplished. Many fruitless attempts to do this were made with the ordinary diving gear, failure being due to the impossibility of the diver dragging along with him so great a length of air pipe. In a letter dated Nov. 19, 1880, Mr. T. A. Walker, the contractor for the tunnel, wrote to the editor of the London *Times*: "Alexander Lambert, a thoroughly experienced diver, who has been employed by me here for some months, offered with a Fleuss' dress to do what was wanted. On the 10th inst. Lambert walked 1,020 ft. up the headings, pulled up two rails, shut two sluices and closed an iron door, having been away for an hour and a half wholly cut off from signals." Lambert himself wrote: "This work was accomplished after many unsuccessful attempts with the ordinary gear, for I found it quite impossible to get up the heading in consequence of the great length of air pipe."

In the case of the last blow-out at the Hudson River Tunnel, where the dress was used for a week by the men employed on the works, and not by professional divers, the Shallow water dress doing away with the helmet was found to be of especial service, as the diver could hear where the air was rushing out, and could get his head into places where it would have been impossible to get it with the helmet on, thereby stopping many leaks that the ordinary diver would have had to leave. (See testimonial appended.)

The Noxious gas apparatus is also worn in the form of a knapsack, with a face mask which is made air-tight by means of an air-cushion and broad straps at the back of the head; and much valuable work has been done and many lives saved with this apparatus, notably, at the Seaham Colliery.

The following is an extract from the Preliminary Report of Her Majesty's Commissioners, appointed to inquire into accidents in mines, and the possible means of preventing their occurrence, or limiting their disastrous consequences: "On one important subject, namely, the possibility of enabling men to enter and to carry lights into deadly gases, or even under water, we have lately examined the various contrivances of Mr. Fleuss, for enabling men instructed in their use effectually to prosecute their work under a considerable depth of water or amidst the most deleterious vapors. In the workings of the Maudlin Seam of the Seaham Colliery, which contains an accumulation of dangerous gases, resulting from the calamitous explosion of September last, the portable breathing apparatus of Mr. Fleuss and his protected lamp have now been employed for some weeks. Their application in the reopening of the works has been of great advantage, and has inspired much confidence in those engaged in these critical operations."

At Killingworth Colliery, where, by the falling in of a shaft, nine men and a boy were entombed, on trying to enter the mine by a disused shaft, the air was so bad, through the ventilation being stopped, that the ordinary safety lamps would not burn. The Fleuss breathers and lamps were sent for from Seaham Colliery, which was nearer than London, and the men were rescued, having been 18 hours entombed; and to show how narrow an escape they had, and how necessary it is that such apparatuses should be kept handy, one of the men died after coming to the surface from the foul gas he had inhaled.

The same apparatus is invaluable for entering Smoke, Sewers, Beer vats, etc. We leave our readers to judge of the numbers of fires that might be prevented if such an apparatus were at hand in our manufactories, stores, warehouses, theatres and hotels. At the alarm of fire, smoke is generally the first thing perceived; should a person be able to penetrate that smoke a bucket of water would do in most cases what the fire brigade very often cannot do when it arrives, as the fire has completely got the mastery and the result may be total ruin.

The combined apparatus is especially useful on shipboard, as access can be obtained to a damaged screw propeller, or to a leak in a flooded compartment, or outside the vessel; and for a fire in the hold of a vessel it would be invaluable, as the smoke which precedes the bursting out of flame in these cases is proverbial. These apparatuses can be used by any person after slight instruction, their manipulation being both easy and effectual.

On Thursday evening we witnessed a test of the Fleuss breather in smoke, given by Mr. Brown at the Repair shop of the New York Fire Department, 180 W. 3d street, in presence of Chief Shay, several other officials of the department, a city alderman and some newspaper reporters. In a narrow brick cell dense smoke from burning rags and cotton waste saturated with oil, was produced and confined. Mr. Brown, wearing a breather, remained in this dense atmosphere of smoke and heat without a chance for communication with the outside air for over thirty minutes, which was considered a test fully as good as a more lengthy one would be. No person unprovided with artificial aid to breathing could have endured such an atmosphere for three minutes. The firemen, rather apathetic at first, were well pleased at the test, and became quite interested after seeing it carried out. The Fleuss lamp was taken into the cell by Mr. Brown, and elicited the warm commendations of the firemen.

They are manufactured by Messrs. Fleuss, Duff & Co., of London, Eng., whose agent, Mr. J. B. Brown, is now in this country, and can be addressed at 81 East Tenth street, New York.

THE ENGLISH CHANNEL TUNNEL AND CARBONIC ACID GAS.

(London Times, May 6, 1882.)

To the Editor of the Times:

SIR: With reference to the proposal which my excellent friend Dr. Siemens is reported to have laid before our military authorities, would you permit me to describe a small experiment? Coming down here from London to-day, on a part of the line where our speed was about 30 miles an hour, I took out my watch and determined how long I could hold my breath without inhalation. By emptying my lungs very thoroughly, and then charging them very fully, I brought the time up to nearly a minute and a half. In this interval I might have been urged through more than a half mile of carbonic acid gas with no injury and with little inconvenience to myself. Indeed, supposing the tunnel to be entirely filled with carbonic acid gas, I have sufficient confidence in my friend's ability to wager that in six hours he would be able to devise a means of sending troops safely through it. *The problem of supplying fresh air to persons surrounded by an irrespirable atmosphere has been already solved by Mr. Fleuss and others.*

Your obedient servant,

Haslemere, May 2. JOHN TYNDALL.

NEW YORK, Sept. 9th, 1882.

J. B. Brown, Esq.:

MY DEAR SIR: In our recent *blow out* at the heading of our works on this side of the river, and the usual inflow of water, we found your Fleuss diving apparatus of very great service in regaining control of the heading. Our workmen, although not accustomed to its use, worked it very efficiently and successfully. I shall try to secure an outfit and keep on hand ready for such emergencies in the future. It speaks loudly for itself when the occasion arises for its use. Trusting we shall not have occasion to use one for some time to come, I remain, Yours respectfully,

D. C. HASKIN, Manager.

THE HYDROGRAPHIC OFFICE.

WASHINGTON, Sept. 11.—The Hydrographic Office of the Navy is a department of our naval service which deserves to be better known than it is, since its usefulness is by no means limited to the navy proper. By some persons it is sometimes confounded with the coast survey, but the two branches of the service are widely different. Not only does the Hydrographic Office accomplish most valuable results in increasing the general stock of knowledge concerning the navigable waters of the world, but it affords a valuable training to a large number of naval officers, and increases their fitness for the command of our vessels. The last official register shows that there were in January 22 officers thus employed. The office is in charge of a commodore, who has as his assistants, one commander, five lieutenant commanders, four lieutenants and 11 masters. The present chief is Commodore De Krafft, an able and experienced officer, through whose courtesy the following interesting information has been obtained :—

HOW THE OFFICE WAS ESTABLISHED.

The Hydrographic Office, as it now exists, was established by act of Congress, approved June 21, 1866, which provided that "there shall be a Hydrographic Office attached to the Bureau of Navigation, in the Navy Department, for the improvement of the means for navigating safely the vessels of the navy and of the mercantile marine, by providing, under the authority of the Secretary of the Navy, accurate and cheap nautical charts, sailing directions, navigators, and manuals of instruction, for the use of all vessels of the United States, and for the benefit and use of navigators generally," etc., etc. It is the aim of the Hydrographic Office to make this country independent of foreign sources of supply in providing charts and other hydrographic information to our navy and mercantile marine, and to co-operate in the circulation of all knowledge that may be useful to navigators. This information, in the main, takes the form of charts, books and notices. Each of the great maritime powers has its hydrographic depot, and between these there is constantly going on a free exchange of all new data deemed of sufficient importance for publication. Let each strive to be independent of the others in respect of what is already known; hence, when a chart is published from an original survey made by one depot, it is the object of other depots to publish this chart in its own way for the benefit of its own country. It is thus seen that the work of our Hydrographic Office is not confined simply to the publication of its own hydrographic surveys, and it is a fact that the greater number of our charts are derived from foreign sources. The vast amount of labor and detail involved in this scheme is at once apparent to those who have had experience in surveying and "bringing up the work;" but it is probable that only a vague idea rests in the minds of the people at large in reference to the matter. There is no time when the Hydrographic Office could not usefully employ as many officers as the navy can spare from other duties, and the cry is constantly going up for more officers. Since the information to be published is for sailors, they are the best judges of what should be given, and as the analysis, or translation or origination of the work often calls for the eqercise of a considerable scientific knowledge, naval officers are especially well fitted for the task.

WORK FOR NAVAL GRADUATES.

The hydrographic office fulfills another purpose of great value to a country like ours. From the nature of its work, it is one of those naval institutions which provide a post-graduate course of practice in the scientific, mathematical and professional principles taught officers at the Naval Academy, without which an officer's knowledge in time of peace would either be forgotten or reduced to mere abstrict ideas which could not be immediately applied in emergencies. Incidentally, it may be said that the same useful practice is given to those officers who serve as instructors at the Naval Academy, and to those who are at the Naval Observatory, Nautical Almanac Office, in the Coast Survey and in the several bureaus at the Navy Department, etc. It has been said that the worst use to which a man can be put is to hang him. Certainly no educated officer can be put to a worse use than on "waiting orders," when he is of no use whatever. To put any line officer on "waiting orders" should be a last resort, the necessity for which should be plain. Take a lieutenant for example, who gets $1,600 on "waiting orders" when he is absolutely dead to the service for the time being, and $2,000 on shore duty, when the education which the country has generously given can be utilized to the utmost. Here is $1,600 for doing nothing, and $2,000 for doing something, and if that something cannot be made worth more to the country than the $400 per annum difference ($1 10 per diem), there must indeed be something "rotten in Denmark." Our navy should be small, but no smaller than will provide an expansive nucleus for a war footing, and it becomes necessary, therfore, to prove some warrant for its existence on such a basis, and this is found in the fact that the officers can be made as useful in peace as in war. This is a growing country, and naval officers should be encouraged to help the growth rather than to be drones sapping the public purse. The country will discover after a while that such places as the Hydrographic Office can provide useful work for the talented graduates of the Naval Academy, and will then insist on a stoppage of this bad practice of "waiting orders"—in pay and out of practice. A few years ago it was difficult to find naval officers experienced in surveying, but so far is this from being the case now that any man-of-war afloat can be ordered to proceed immediately to surveying duty, with the surety that there are experienced surveyors on board who have done field work in the navy or coast survey, or both. And to this duty vessels are constantly being put.

WHAT THE OFFICE ACCOMPLISHES.

The Hydrographic Office, in concert with the Bureau of Navigation, of which it is a branch, draws up schemes of surveys and directs their execution, prepares projections, sifts plots and arranges the field work, prepares the drawings for the engraver or lithographer, and finally publishes the chart in the best shape for the navigator. The Division of Drawing and Engraving is intimately connected with this branch of the work. The duties of the other divisions may be stated as follows : Up to the present time 912 different charts have been published by the Hydrographic Office, which, with but few exceptions, are of ports outside of the United States, charts of the same ports being made by the Coast Survey. These charts are constantly being corrected, as the data for correction, contained in "Hydrographic Notices" and "Notices to Mariners," comes into the office. All bars to the safe navigation of the waters and harbors of the globe, all changes in the outlines of the various coasts, all discoveries of dangers and doubtful dangers in the oceans, streams and harbors of all countries, and all changes in lights and lighthouses, fog signals and buoys are noticed on all charts affected by them, and these constant corrections on numerous charts keep a force of three naval officers and one civilian draughtsman in the Chart Division constantly employed. This work is sufficient to keep at least double this force employed all the time. All United States vessels of war are supplied with their charts directly from the Hydrographic Office. Merchant vessels get their charts from agents in the several seaports on our Atlantic and Pacific coasts for simply the cost of the paper and printing.

PRINTED AND PHOTOGRAPHED CHARTS.

All American charts are printed in the Printing-Room of the Hydrographic Office, from plate engraved from the original surveys by our own naval officers. The demand for these charts is so great that a force of four printers is kept constantly employed. Most charts from British or other foreign surveys are photo-lithographed by contract; but on account of the many difficulties experienced with these charts heretofore it is now proposed to transfer them to plates. Copies of all charts published by the British Admiralty and not yet reproduced by our own office (about 8,000 in number) are kept in the British Admiralty Chart Room, and are issued to vessels of the United States navy only. These charts, likewise, are kept corrected from charts of later date, from information received from United States vessels and other reliable authority. All of this work is done with care by skilled naval officers and draughtsmen, as upon the accuracy of the charts depends the safety of vessels and the lives of the crews.

DUTIES OF THE OFFICERS.

For the proper performance of the work in this division five officers are necessary, and about this number have been employed during the past year. Their duties are divided as follows:—One chief of division, who has charge under the Hydrographer, and exercises a general supervision; one lieutenant master, or ensign, in charge of lights, lists, and sailing directions, and acting as translator; one lieutenant master, or ensign, in charge of the catalogue of archives, and of the standard charts, and acting as translator; two lieutenant masters, or ensigns, engaged in the preparation of notices. In the preparation of these latter the information is grouped, as far as possible, so that all relating to one squadron may occupy a separate notice. After being arranged by the chief of division, it is turned over to one of the officers whose duty it is to prepare the notice for the printer, and the latter, by reference to an index chart and the various sailing directions and light lists, ascertains which of these is affected, and attaches this to the notice. The latter is then sent to the Assistant Hydrographer, who scrutinizes it, and afterward sends it to the Hydrographic and British Admiralty chart rooms, and any errors or omissions in the chart references are corrected. Finally, on a requisition signed by the Hydrographic and the Chief Clerk of the Navy Department, the matter is sent to the Public Printer, and, after two proofs are read at the Hydrographic Office, it is issued to the various squadrons, navy yards, agents, and to any shipmaster who may write for a copy.

AN ENORMOUS AMOUNT OF WORK.

While the notices are in preparation, the various charts and light lists which may be affected are corrected to correspond, and after publication the notices are cut into slips and the latter pasted in the books of sailing directions opposite the pages to which they relate. Twice each year, on the 1st of January and the 1st of July, a supplement to each light list is published, containing all changes for the previous six months. These changes are so numerous that every two or three years a new edition of each of the six numbers of the light list is prepared, affording navigators a complete and accurate description of all the lights in the world. The Danish, Swedish, Norwegian, German, Dutch French, Spanish, Austrian, Portuguese and Italian notices require to be translated; the Russian are published in French, and the more important Chinese and Japanese notices are received already translated into English, and all the others are published in that language with the exception of the Turkish, which are also in French. During the fiscal year ending June 30, 1882, this division prepared 116 notices to mariners and 85 hydrographic notices, containing from one to fifty pages and from one to 150 numbered paragraphs each.

OCEAN METEOROLOGY.

The Meteorological Division of the Hydrographic Office has charge of the collection of data of all kinds pertaining to ocean meteorology and of reducing this data into such shape that it will be of the greatest use to the mariner. All national ships are obliged to keep a daily record of weather phenomena. Beside which the office has a large corps of volunteer observers aboard merchant ships of almost every nationality. As the logs are received they are inspected to see that they have been kept according to the required standard. If they are found to be correct all data is compiled and condensed and laid aside for future use. Charts of the seven oceans of the world are divided into five degree squares, and for convenience of reference each square is numbered. After all the data has been grouped into five dozen squares it is again reduced, and a monthly mean for each month of the year is obtained. This monthly means at times represents the observations of hundreds of ships that have passed through the square, some only taking a few hours and others days. Four years ago this office published a Meteorological Chart of the North Pacific Ocean. To-day it has in the hands of the engravers a chart of the North Atlantic Ocean, which will be published very shortly. Data for a South Atlantic chart is almost ready. As the work of reducing and grouping the observations requires a certain amount of technical education, it is done by our naval officers. At the present moment there are hundreds of log books in the Navy Department that have never been examined, and a force of twenty officers could be most advantageously employed for the next five years in extracting and preparing the data for publication. It is the design of the office to publish meteorological charts of all the oceans, and it has been only on account of the lack of adequate force to compile and reduce the data that it has not been more rapidly executed. With these charts at hand the mariner will be enabled to see at a glance the past experience of hundreds of navigators in respect of weather at sea, and will thus be enabled to form a good judgment of the best route from port to port in any sea and in any season.

LIBRARY AND BOOKS.

The Division of Library and Books has charge of the issue of hydrographic book publications of all kinds. It also has charge of the Hydrographic Office Library of reference, in which hydrographic information in all languages may de found. During the year ending July 30, 1882, 1,033 volumes of sailing directions and 3,842 other publications were issued through this division to authorized agents and to our vessels of war. Three officers find employment here in keeping the expenditure and receipt books of the office and in correcting sailing directions, etc.—*N. Y. Telegram.*

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, SEPTEMBER 16, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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PHILADELPHIA SCHOOL OF SEWERAGE.—At the meeting of the Homœopathic Medical Society in Hahnemann Medical College, the secretary, Dr. Mohr, reported that the recommendations of the city in favor of egg-shaped sewers had been complied with by Councils, and hereafter all the small sewers built would be on that plan. It was also reported that arrangements were in progress looking to the delivery of a lecture by Colonel Waring on the sewerage system of Philadelphia, but had not yet been completed.—*Philadelphia Times*, Sept 15.

◆

THE EDISON SYSTEM OF ELECTRIC LIGHTING.

A certain quantity of electricity passing through a good conductor produces no physical effect on the conductor: but a constriction in the conductor or an interposition of a material that is not so good a conductor causes an effect analagous to that of a large quantity of water violently forced through a small pipe—a crowding of the particles ensues, creating friction and consequent heat. Upon this simple principle all electric lights operate. In both the arc and incandescent lamps there is a resistance present at the point of illumination, and heating occurs.

It is our purpose in what follows to briefly describe the recently inaugurated Edison system of electric lighting as now in operation in this city.

The Edison Electric Light Company was organized in October, 1878, with a capital of $300,000; this has been increased on two occasions until it is now $720,000. The company owns the patents of Thomas A. Edison, and under them its operations are carried on. Although the lamps and dynamos of Mr. Edison have been extensively used both in this and foreign countries, nothing was tried in the way of general illumination from a central station until the dynamos were started in this city on the 4th inst. This district embraces the area bounded by Wall, Nassau and Spruce streets and the East River; the dynamos are located at Nos. 255 and 257 Pearl street. During the early part of the present week we visited the general offices of the company at 67 Fifth avenue, the central station, and also many of the users of the new light.

THE STATION.

The boiler room is located in the basement of the building. There are now in place four Babcock & Wilcox boilers and four others are being prepared, which will give an agregate horse-power of 2,000, working under a pressure of 120 pounds. The four boilers are arranged in pairs facing each other and at a sufficient distance apart to permit the fireman to attend the furnaces. The coal is received in bins placed under the sidewalk, and is then shoveled into a trough in which works a screw, and which leads over the first set to the space between the boilers. The ashes are thrown into a receptacle under the flooring and conveyed out by the same plan. A Sturtevant blower furnishes the blast needed by the boilers, fresh air for ventilation and for the dynamos, as will be mentioned later. Two smoke stacks, one for each set of boilers, extend up through the centre of the building to the roof.

The first and second floors of the building were removed and an iron superstructure erected entirely independent of the walls of the building, and resting on separate foundations. On this the dynamos are placed. We could not obtain a satisfactory explanation to our query as to why the heavy machinery in rapid motion was elevated and the dead load placed on a solid foundation in the basement.

THE DYNAMOS.

There are six dynamos now in position (this number will be doubled as soon as the equipment is completed), the armature of each being driven by a Porter-Allen engine having a cylinder diameter of 11⅝ in. and a stroke of 16 in. These are directly connected and are expected to make 350 revolutions per minute.

The armature is of the Siemens pattern: its foundation, or core, which is built upon the shaft, consists of a series of sheet iron discs, separated from each other by layers of thin paper and bolted firmly together. This method of constructing the armature, while it has all the advantages of solid iron, prevents the great loss of power due to induced or local currents, which would be present if it was one piece. The face of the armature is made up of heavy copper bars, having a trapezoidal cross-section, their dimensions being ¾ by $\frac{11}{16}$ of an inch. To insure a perfect insolation, each bar is wrapped in Japanned paper and separated from the iron core beneath it and from its neighbors, by an air space.

There are the same number of copper discs as there are bars, one half being at each end of the core. Each disc has two projecting lugs, one on each side, these lugs being placed nearly but not quite diametrically opposite to each other. These are bolted together so as to form, with the iron discs constituting the core, one solid mass. Each end of every bar is connected to one of the lugs.

Air from the blast enters horizontally opposite the center of the armature, and, as the spaces above mentioned permit of a free circulation through the parts, all liability of the accumulation of heat is prevented and the capacity of the machine greatly increased. In order to resist the centrifugal force developed by the high rate of speed, the bars on the armature are wound with piano wire at certain places.

The commutator in these dynamos consists of 49 bars of copper placed longitudinally on the shaft and separated from each other by an insulating material and connected with the armature bars. So, each bar on the commutator forms the terminus of a continuous loop or convolution through the copper rods and discs on the armature.

The brushes are composed of alternate layers of fine copper wire and plates soldered together.

The armature is 27.8 inches in diameter and 61 inches in length; the armature shaft is of steel, 7¾ inches in diameter and 10 feet 8 inches long; the commutator is 12¾ inches in diameter and 18 inches long; the journals are 6½ inches in diameter, 15 inches long, and have Babbitt metal bearings in pillow blocks of the box pattern. In order to prevent undue heating by friction, constant lubrication is provided for and there is a continuous current of water flowing beneath the boxes.

The magnet is composed of two large pole pieces of cast iron, having semi-cylindrical faces, between which the armature revolves. These poles are 49 inches wide and 61½ inches high. To these poles are attached twelve cylindrical cores of soft iron, wound with coarse copper insulated wire, through which the electric current passes. Four of these cores are attached to the lower pole piece and eight to the upper. The twelve cores are 57 inches long, the eight upper ones having a diameter of 8 inches and the four lower ones 9 inches. There are four soft iron keepers, 11 by 9 inches securely bolted together and attached to the cores.

The current from one of the mains of the commutator passes through the wire wound upon the nearest middle core, thence to the one directly above; then to the one beneath; from here it takes the same course through the other three vertical sets in succession. Before entering the other main the current circulates through a resistance which increases or diminishes the magnetic strains as may be needed by the demands.

A safety catch is placed on each dynamo. This consists of a break in the conducting wire which is filled with a piece of metal having a low fusion point. Should any undue heating occur, this metal is fused, and a break thereby caused in the circuit, and the main and lamps saved from any possible injury.

Each of the six dynamos weighs as follows:

	Lbs.
Armature and shaft	9,800
Two pillow blocks	1,040
Magnet, complete	33,000
Zinc cases	980
Total	44,820

The copper used in construction is distributed as follows:

	Lbs.
Armature bars	540
Armature discs	1,350
Magnet wire	1,550
Total	3,440

The magnet rests upon insulating bases of cast zinc 8 in. thick. The dynamo and engine are mounted on a base plate of cast iron, made in two parts for convenience, and bolted together.

This bed plate is 14 ft. long, 8 ft. and 9 in. wide, and weighs 10,300 pounds. The entire weight of the steam dynamo is as follows:

	Lbs.
Dynamo	44,820
Engine	6,450
Base plate	10,300
Total	61,570

After leaving the dynamo the current passes through a circuit breaker, which consists of two sets of copper plates, the upper set being so arranged that it can be raised free from the lower, or depressed, so that the plates will overlap and insure a perfect contact.

The electric current from all the dynamos is led into a common main, from which branch the various feeders leading into the street and supplying the district.

A test line leads from the dynamos to a room upstairs, upon one wall of which are grouped one thousand lamps, so arranged that any number of them can be placed in the circuit. The current from any one of the dynamos can be sent through the test line to the lamps and its power thereby ascertained, and its real working condition or capacity obtained.

Each of the dynamos has the nominal power of a 1,200-light machine at 16 candle-power incandescence. This can be readily increased to 1,400 lights of the same power without heating the armature or in any way heating or burning the brushes or commutators. This result is accomplished most economically, and is due to improvements in the lamp itself.

The mains, which may be said to collect the current from the several dynamos, lead along one wall of the room to the front where the connections are made with the feeders. At this point a piece of low fusion metal is inserted in each of the bars of the feeders in the same manner and for the same purpose as already described.

In the room above is an indicator for keeping the electro-motive force within certain defined limits. The current passes through an electro magnet, before the face of which is an arm held back and away by a spring. The power of the magnet depends upon the electro-motive force passing through the coil. A too powerful or too weak current is shown by the lighting of o red or a blue incandescent lamp. Watching these lamps, the attendant, constantly at hand, throws in or removes resistance coils as the case may require.

THE DISTRIBUTING SYSTEM.

The word "distributing" may be aptly applied to the method of placing the electric current at the disposal of the patrons. An iron pipe is laid underground through the streets, and protects two heavy semi-cylindrical bars of copper, which are perfectly insulated both from each other and from contact with any outside object. At the station each of these bars is connected with the mains from the machines as already described. These bars enter an iron box at every place where it is desired to "tap" the current, and wires are attached leading into the house. Low fusion metal is here again inserted. The box is then filled with an insulating compound and the caps securely bolted in place.

METERS.

Each consumer is furnished with a meter consisting of a bottle containing sulphate of zinc, in which is immersed two bars of zinc, kept at a constant distance apart. An infinitesimal portion of the current passes through the meter, causing a decomposition which increases one of the zinc bars and decreases the other. At stated times these bars are taken to the station, and the difference ascertained. As a certain quantity of electricity will produce an invariable effect—in this case decomposition—the quantity which passed through the meter can be readily computed, and as this bears a known ratio to the current entering the premises, that can also be found. One most decided advantage in this arrangement is that the consumer pays only for what he uses. "An inferior 'quality' of the illuminant will never affect the reading of his meter."

THE LAMP.

The lamp consists of an exhausted bulb of glass, pear shaped, and containing a loop of carbon made from bamboo, and of a thickness a little larger than a horse hair. The ends of the loop terminate in two platinum wires passing through the ceiling, and so situated that when the lamp is placed in its socket these wires will form contact with those leading from the street and carrying the current. By turning a key the current can be shunted from the lamp. An accident to one lamp has no effect upon any other in the same circuit. Each lamp is provided with a portion of the low point fusion metal so often noted.

FIRE PRECAUTIONS.

It is one of the laws governing the action of dynamic electricity that an absolutely complete circuit must be established before we can obtain any current and upon the severing of this circuit at any point all effect instantly ceases. As stated in the beginning of this article, heat will be developed where there is the most resistance. Owing to these reasons Mr. Edison has adopted the most effectual means for breaking the circuit and destroying the current before any dangerous amount of heat could be developed. A metal with a low fusion point, or one which will open the circuit at a low temperature, has been placed between the severed points of the conductors at every point where its guardian powers were deemed desirable. In case of the destruction of this metal at any place it can be easily and quickly renewed after the cause has been ascertained. No danger is possible from the lamps themselves, as the fracture of the globe destroys the light instantly.

Interior illumination by incandescent lamps may be considered one of the institutions of this city, and judging from the favor with which it has been received, its growth is only a question of time—a short time at that. The steadiness, color and brilliancy of the light commend it for almost any purpose, and its absolute freedom from noxious vapors will endear it to all lovers of pure air.

PAINTING THE BROOKLYN BRIDGE.

In June last the trustees of the New York and Brooklyn bridge advertised for proposals for furnishing about 10,000 gallons of paint, to be made according to the following formula: 70 pounds first quality white oxide of zinc; 30 pound of best white lead; 6 gallons raw Calcutta linseed oil, with such staining material as may be necessary to give the desired color. The paint to be ground and to weigh not less than 18 pounds per standard gallon. In order to see that these conditions would be complied with, the trustees stipulated that they be allowed to place an inspector in the manufactory of the contractor and to whom should be afforded every facility for examining the material, process, packing, etc. Should any of the paint be found to contain other materials than those specified the trustees had the right to annul the contract and to obtain any balance that might be from such sources as would be for the best interests of the work; but if the cost be more than that of the contract then the contractor will be held for the difference in price.

On July 5 the following bids were opened:

	Per gallon.
Ed. Smith & Co.	$1.32
" " second bid	1.28
Seeley Bros	1.20
Chas. E. McBride	90
Harrison Bros. & Co	1.40
N. J. Enamel Paint Co.	1.35
C. A. Woolsey	1.16¼
E. Blunt	1.20
F. W. Devoe & Co.	1.28
C. T. Raynolds & Co	1.25
John W. Masury & Son	1.15
" " linseed oil	1.05
H. W. Johns Mfg. Co.	1.47
W. P. Husband	1.65
Union White Lead Mfg. Co. Paint, 8 3-10c. per lb. Raw Am. linseed oil, 63c. per gal.	

The bid of Chas. E. McBride at 90 cents per gallon was withdrawn and the contract awarded to Messrs. Masury & Son at $1.15.

The position of the bridge subjects its iron and steel work to atmospheric influences which are extremely corroding. Under these circumstances the formula above given for mixing the paint was believed to be the most advantageous that could be obtained. It was also believed that not only would the surfaces be perfectly protected, but that the paint itself would have such durable qualities that its renewal would be unnecessary for some time.

In speaking of the condition that the paint must weigh 18 lbs. to the gallon, one of our esteemed contemporaries states that, "Made up with all honest intention, so as to give as good a paint as the formula is capable of making, the weight will be but 17¼ lbs. per gallon. Sealed up in tin cans this paint will weigh just 18 lbs. per standard gallon." We were informed by Mr. C. C. Martin, First Assistant Engineer of the bridge, that one U. S. sealed gallon, on Fairbanks' standard scales, weighed over 18 lbs.

In order that there may be no deception, small quantities of paint from the same package will be analyzed by the contractors and by the bridge authorities, and the results compared. This will be repeated as often as may be deemed essential to the best interests of the work.

The task of painting the bridge is progressing rapidly. The paint is mixed with oil by the company in such proportion as will render it of the desired consistency. No dryer is used, as, when ten or twelve hours of dry weather seem assured, there is no danger of a subsequent washing. When considered necessary, one will be used. French ochre is used for coloring, and is obtained direct from the importers.

Mr. W. B. Adams is in charge of the small army of painters. This gentleman has had much experience in this class of work, and is now engaged in painting the just-completed Kinzua viaduct.

Some sections present many difficulties, and all require constant care and a perfect absence of any liability to dizziness. The painters straddle the cables working backward. When it is remembered that these cables are about the size of a barrel, and are at a great distance above water level, the operation of reaching under to paint the lower side becomes one of great nicety. The suspender rods are painted by a man swung from the cables. The trusses present no special difficulties. Under the floor beams a stout plank is suspended which is long enough to cover three beams. Six men, one upon each side of each beam, sit upon the plank and work. By this means a man only paints the surfaces which face him. The plank is shifted in a direction parallel to the beams. A close inspection of the work already done failed to reveal a blank spot, clearly proving the thoroughness of the work. In all probability only one coat will be put on this fall.

PERSONAL.

T. F. SICKLES is Chief Engineer of the West Virginia Central & Pittsburgh Railroad.

CHIEF ENGINEER MCWILLIAMS, of the Wheeling & Lake Erie road, has resigned, and it is said will be succeeded by Mr. C. F. WILSON.

W. J. KIRK was elected Chief Engineer and Superintendent of the Atlantic & French Broad Railroad at the annual meeting held at Belton, S. C., on Aug. 17.

MR. FRANK SHANLY, a well-known civil engineer, who, with his brother, constructed the Hoosac Tunnel, died on the cars Wednesday morning, between Mallorytown and Brockville, Ontario.

SIR FREDERICK BRAMWALL, the engineer who is promoting the English Channel Tunnel scheme, arrived in this city by the Parthia on the 13th. He intends to spend a few weeks here in rest and recreation, but will inspect some of our most prominent engineering undertakings.

MR. P. L. INNES, for some time past Principal Assistant to D. C. LINSLEY, Contractor and General Manager of the Canada-Atlantic road, resigned his position, on Aug. 20, to become a partner with Messrs. COOK & JONES, contractors for the Toronto harbor and island improvements for the Dominion government. The firm is now COOK, JONES & INNES.

THE death of EMILE PLANTAMOUR, the Swiss astronomer, at Geneva, on the 14th, is announced by cable. He was born in Geneva, May 24, 1815, and studied at the University of Kœnigsberg, where he was created a doctor of philosophy in 1839. He was subsequently appointed Professor of Astronomy and director of the observatory of Geneva. In 1865 he was elected a correspondent of the French Institute, previous to which he was elected a member of the Society of Physics and Notural History of Geneva and of the Astronomical Society of London. Besides his annual publications on his astronomical observations he wrote a Latin thesis, *Disquisitio de methodis traditis ad cometarum orbitas determinandas*, and several other works on his favorite science.

A NEW driver, fresh from the country lyceum, was initiated into the horse-car business on one of the Norwich routes the other day. The peculiarities of his style in collecting fares excited the mirth of his first car-full of passengers. After he had finally collected all the money that he reckoned was due him and escaped to the platform, a couple of girls tittered. He wheeled round solemnly and remarked in the parliamentary language of "Cushing's Manual:" "If any of you people hain't paid their fares they will please manifest it by rising."—*New London Day.*

NEW YORK, WEST SHORE AND BUFFALO RAILWAY.

This company is now vigorously pushing its track-laying in Rockland, Orange, Ulster, Albany, Schenectady, Oneida, Madison and Onondaga Counties. Up to the 9th inst., 37 miles were laid. Track material for about 125 miles of double track is distributed along the line ready for use. Iron bridge superstructure was also erected at that date to the amount of 980 tons, with a further amount of 6,400 tons manufactured and in process of erection.

The construction of passenger and freight stations, engine houses, turn-tables, tank houses, wells and pump houses, is also in progress at Newburgh, Kingston, Milton, Catskill, New Scotland, South Schenectady and Canastota. Contracts have also been awarded and construction will be immediately begun on the passenger and freight stations at Marlboro, Highland, Esopus, Glasco, Coxsackie, Saugerties, Coeymans, West Athens and other points.

The great tunnel at Weehawken is rapidly approaching completion; on the 1st inst. only about 740 ft. (or 19 per cent. of the whole length), remained unfinished. It will probably be through on or before the 1st of December next.

The Haverstraw Tunnel, of 1,600 ft. in length, is completed, and the West Point Tunnel, of 2,660 ft. in length, is now within 130 ft. of completion. It will, in all probability, be finished by Nov. 15.

The force working on the line between Weehawken and Middletown, and Cornwall Junction and Syracuse, on the 1st inst., was: 19,000 men, 120 steam and compressed air drills, 17 steam excavators, 3 dredging machines; total equivalent in "men," 28,400. And in addition thereto, 3,781 horses, 37 locomotive engines, 1,242 cars, 16 pile-drivers, 65 steam derricks, 8 steam pumps, 28 tug-boats, scows and barges.

WALTER KATTÉ, Chief Engineer.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 317.)

CCCLXXIX.—AGAWAM.

Agawam, Massachusetts, in lat. 42° 5' N., long. 72° 40' W., is in a rolling country, on the west bank of the Connecticut River. Settled in 1660, it was incorporated as a town in 1857.

Water-works were built as a private enterprise in 1877 by C. L. Goodhue, taking the supply from springs flowing from the base of a bluff, back of which extend sandy plains.

The water is conveyed to the town and distributed through 3½ miles of 4 and 6 in. cement-lined wrought-iron pipe. The ordinary pressure in the mains is 85 lbs. There are 7 gates and 45 taps. There are no fire hydrants. The town pays $50 per year for one public watering trough. Service pipes are of galvanized iron.

The population in 1880 was 2,001. The daily consumption is not given.

The works have cost $6,000. The expenses are very small. The receipts in 1881 were $540.

CCCLXXX.—DOVER, DEL.

Dover, Delaware, in lat. 39° 10' N. long. 75° 28' W., is on level ground on St. Jones's Creek.

The town was settled in 1683.

Water-works were built for the city in 1882 by the Holly Manufacturing Company, taking the supply from a well 15 ft. in diameter and 22 ft. deep, sunk through 17 ft. of water-bearing strata. The water is pumped directly into the mains by two Gaskill steam pumping engines, under 40 pounds pressure for ordinary service.

Distribution is by 2½ miles of cast-iron pipe of 8, 6, and 4-in. diameter, with 28 fire hydrants and 10 gates. The works have just gone into operation, and the number of taps is not given. The maintenance and interest on bonds will be paid from a special tax. Service pipes are of lead and of galvanized iron.

The population in 1880 was 3,000.

The works have cost $20,000, which is the amount of the bonded debt at 4 per cent. interest.

The works are managed by a Water Committee of the Council. John A. Nicholson is Chairman, and George P. Jarrett the Superintendent.

[TO BE CONTINUED.]

The receipt of statistics, as follows, is acknowledged with thanks:

From C. L. Goodhue, statistics of the water-works of Agawam, Mass. From J. A. Nicholson, Chairman of Water Committee, statistics of the water-works of Dover, Delaware.

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MEXICAN NOTES.

CITY OF MEXICO, Aug. 30.

Since the opening of the Central Railroad as far as the city of Leon great numbers of persons from the interior are arriving here daily to visit the capital, many of whom come to the city of Mexico for the first time in their lives, and would probably have gone to the other world without having seen the capital of the republic, if they had been doomed to make the trip in a diligence and expose themselves to a meeting with some band of highway robbers on the road. The railroads are changing the face of things in this country and bringing progress to the land of Montezuma in a most remarkable way. The Hotel Iturbide, which used to be the palace of the emperor, and which is immensely large, is having a new wing built, as it can no longer accommodate the passengers who apply for apartments. The Hotel San Carlos has also erected an additional wing, and several new hotels and boarding-houses have been opened to the public within the last two months.

The number of kilometres of railway built in the republic up to the first of this month has been officially published as follows:

	Kilo.
From Vera Cruz to Mexico City and Branch to Puebla	371
From Vera Cruz to Jalapa and Coatepec	144
From Vera Cruz to Medellin	22
From Esperanza to Tehuacan	50
From Merida to Progreso	36
From Mexico City to Leon	409
From Mexico City to Toluca	73
From Mexico City to Cuantla	138
From Paso del Norte to Chihuahua	300
From Puebla toward San Martin	38
From Puebla toward San Marcos	34
From Vera Cruz toward Anton Lizardo and Avarado	25
From Vera Cruz toward Jalapa and Chalchicomula	19
From Pachuca toward Irolo and Teoloyucan	45
From Altata toward Culiacan	30
From Merida toward Peto	28
From San Luis to Soledad	6
From Tampico toward San Luis	38
From Mexico City toward Salto, San Bartolo and San Luis	83
From Matamoras to Monterey	7
From Zacatecas toward San Luis	23
From Reyes to Tepetlaxtoc via Texcoco	28
From Nuevo Laredo toward Monterey	170
From Guaymas toward Magdalena	200
From Puebla toward Metamoras Izucar	23
From Chalco to Tlalmanalco	15
From Tramways in the Federal District, Puebla, Guadalajara, etc	130
Total	2 636

The legislature of the State of Michoacan has authorized the executive of that State to obtain a concession from the federal government for the construction of a railroad line to connect the capital of Michoacan with the Central Railroad at any point which may be deemed most convenient. The concession will be transferred to the company or companies which may be best able to guarantee the conclusion of the work.

According to a letter received here from a well-known citizen of Texas, Count Telfner will resume work by the beginning of next month on the railroad that runs on the coast of Texas and is to cross to Matamoras, passing through San Fernando, Victoria, Tampico and Tuxpan, with branches to this city.

The Department of Public Works has authorized the Mexican National Railroad Company to open its Toluca Division to the public.

The horse railroad from the town of Guadalupe to the city of Zacatecas, which belongs to the Mexican National Company, carried 38,901 passengers during the month of June. The new horse railroad which runs between Orizaba and the town of Ingenio was inaugurated a short time ago with great festivities and enthusiasm. This road is already doing a very good business.

The *Diario Oficial*, the organ of the government, has published lately several communications relating to the Tehuantepec Railroad, and among them one addressed to the Governor of the State of Oaxaca, in which he is instructed to proceed at once to the organization of gangs of workmen, up to the number of 6,000 for the present, in order to prosecute work as actively as possible on the above railroad, the construction of which the government is resolved to take into its own hands.

To-day's papers announce that the works were inaugurated on the 24th inst., in Tehuantepec, when a large number of persons were present, including the authorities, the most distinguished citizens and the corps of engineers definitely organized under the orders of Mr. Alexander Prieto.

A convoy of specie recently arrived at the town of Maravatio from the city of Morelia, bringing the sum of $125,000 for the National Construction Company. Work on that section of road, as on others, is rapidly progressing.

Orizaba, overrun with railway passengers arriving at and leaving that city, is clamoring for a sitting-room to the Mexican Railroad Company's station.

All these straws show how the railroad age is advancing in Mexico, thanks to the present state of peace and tranquility.—*Correspondence of N. Y. World, 15th inst.*

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THE SEPARATE SEWAGE SYSTEM.

It is unfortunate that the separation of sewage and rain water in town wastes has been developed into a "system," and as such been treated in a commercial rather than an engineering spirit. The result of extravagant riding of any hobby is that an antagonism is excited which ought not to exist, and the good which exists on either side of the matter in dispute is overlooked or its very existence denied. Excessively conservative engineers are too apt to deny absolutely that there is any merit in even an old-established and much-used method of procedure which may be taken up by some shrewd person, and widely and enthusiastically advertised and puffed and proclaimed to be a panacea. On the other hand, this very extravagance of assertion captivates inexperienced engineers and amateurs, and they outdo their preceptors in invectives against any application of the fundamental principles of civil engineering which may be compendiously stated to be the application of common sense and science and experience to the solution of problems of construction.

Spasms of specialties like this are not without good results also, notwithstanding their first outcome is often absurd. They shake up the sleepy masses of engineers, who are content to run in grooves of other people's making, and set them to thinking about the real principles underlying their work. The consequence is that the professional men who have minds of their own are led to adopt what the extremists on each side sneer at as a compromise, but is really a wise "natural selection." But in the meantime damage is done to property by ridiculous running to extremes, not to speak of the injury to the temper of the combatants, and the want of confidence created in the public mind by the antagonistic and positive assertions put forth by men who ought to agree.—*Sanitary Engineer, 14th.*

* * *

THE WESTERN MINING EXPERT.

This evening, while smoking an after-supper pipe and talking complainingly to my host of the fraud that had been practiced on the miners in regard to the promised stuffing of these experts, my arm was lightly grasped. Turning, I saw a neatly dressed gentleman standing by my side. He smiled pleasantly when our eyes met, and extended his hand in the most friendly manner. Seeing that he expected me to shake hands, I arose and did so. He called me by name and inquired almost tenderly into the condition of my health. I could not recall this man to memory. Puzzled, I looked at him, and as I looked the broadcloth disappeared. It was replaced by a white apron. The peculiar smell of oil stoves was wafted to me. The vision of a dingy room, papered with cheap brown paper, arose before me. I could see and hear a howling blizzard sweeping through the streets of a dirty frontier town, and my gentlemanly acquaintance, astride of a beer keg, was behind the only barrel of shell oysters I ever saw in western Kansas, dextrously twirling an oyster knife, and, with manners acquired at the University of Geneva, pressing me to wash down the oysters with draughts of Milwaukee beer out of a huge earthenware pitcher. I could not help smiling. Taking a seat by my side, my acquaintance said: "I have quit shucking oysters for Kansas Grangers. I am a mining expert."

During a long talk that followed, he explained to me how the broken-down merchants, saloon keepers and politicians became mining experts. He said they acquired a slight knowledge of chemistry, including a course of fire assaying. They attended a course of lectures on geology. They learned the names of the different ores and country rocks. Then, going to a mining camp, they opened an assay office and claimed to be mining experts; this when they had never been in a mine. I expressed my astonishment, and asked if an actual expert would not be apt to expose them. Shaking his head negatively, he said: "No. No one knows anything about the formation of ore in fissures. These mountains are full of geological contradictions. You cannot safely dispute any statement a miner may make. Of the permanence of leads, of the probabilities of a continuance of a pay streak, of the worth of an undeveloped mine, no one can possibly know anything. Given a fair knowledge of geology, a smattering of chemistry, unbounded assurance and an accurate knowledge of the output and working of famous mines, and any one can safely meet these high-priced experts. The truth is that none of them knows anything, and they are all afraid that the man they are talking to may be the one man in the mountains who thoroughly understands his business and actually knows what the expert pretends to know. I assure you that none of us really know anything. When a valuable mine is discovered, we talk learnedly about it. But why the ore in that particular portion of the fissure is rich, and why the extensions on the vein is generally worthless, and why the pay peters out, no living man knows. We are all humbugs. Almost all of us are for sale, from the examiner of the Little Pittsburgh to the puffer of the Monarch of Silver Mountain; and the opinion of the cheap puffer is just as valuable as that of the high-priced examiner; and neither of them is worth any more than that of the silent Cornishman who twists a drill in tha face of the sixty-fathom level."

My candid acquaintance arose. Laughingly he bade me good night, and, lighting a fresh cigar, he walked out of the hotel. He had given voice to my own opinion about mining experts. It is a great pity that they are not all stuffed and cased. —*Frank Wilkeson in N. Y. Sun.*

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AUTOMATIC INDICATOR FOR DETERMINING MERIDIAN TIME.

There was recently exhibited in the window of Messrs. Queen & Co., opticians and mathematical instrument makers, of 924 Chestnut street, Philadelphia, an automatic indicator for the use of navigators in determining meridian time, latitude, etc. The indicator in question was patented December 8, 1874, and was on exhibition at the Centennial Exposition in 1876. The inventor is John Devlin, 808 North Third street, Philadelphia. President Allen, of Girard College, who is said to be favorably impressed with this invention, has described it as follows: "A hemisphere so placed that its equator coincides with the horizon. A magnetic bar moves freely on a pivot at the pole, and a small piece of wire crosses tha bar at both ends. In places where the magnetic and terrestrial meridian coincide, the shadow of the bar on its pivot will indicate solar or apparent noon, and the shadow of the wire on the south end of the bar falling on the meridian at noon, will limit a certain arc of the meridian between the shadow and the equator. When the sun's declination is south, this arc will be equal to the latitude of the place minus the declination. Therefore, when the sun's declination is known, the latitude of the place may be found by a meridian observation of the dial; and, when the latitude of the place is known, the sun's declination may be found by a similar observation." The inventor claims that the moon's meridian may also be taken with the instrument, is always adjusted for use, and that it is of advantage in cases where the sun appears only for a moment or two, or long enough for the indicator to take the latitude of a ship as shown on the hemisphere, requiring no calculation on the part of the captain. Wa understand that Mr. Devlin sailed for Liverpool on the Illinois some time since, and that on tha voyage a practical test of the merits of this indicator were to be made by the officers of that vessel.

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SUCCESSFUL EXPERIMENTS TO PROPEL STREET CARS BY ELECTRICITY.

A special dispatch from Pittsburgh to the Philadelphia *Press* says: An invention which, it is claimed, will revolutionize the street railroad travel was successfully tested in the yard of the Union Passenger Railroad Company in this city yesterday. It consists of an electric motor designed to propel street cars, which has recently been patented by Dr. J. R. Finney, of this city. A car weighing six tons was used in the experiment. The electro motor was suspended below the level of the floor by a truss attachment to the truck. The only machinery in addition to the simple dynamo machine, rated at one and a half horse-power, was a series of gear-wheels by which the car-wheel was made to revolve once in thirty revolutions of the motor, which propelled the car at the rate of 10 miles an hour. The electricity is produced by a dynamo-electrical machine, located at any point, and is conveyed on a wire suspended a short distance above the car on brackets attached to arms extending from posts set at the side of the track. The current is led from this conductor to the motor by a contract traveler consisting of a grooved pulley, held loosely on the conductor by another pulley on the other side. The current is grounded through the wheels and rails, the latter having a continuous connection, in order to make a more perfect ground. The traveler is drawn along the wire conductor by the car, and the pulleys are so adjusted that they pass over the brackets without breaking the contact, furnishing a constant and steady supply of electric power to the machine, which it transfers into motion, just as the old-fashioned mill wheel converts the weight of water into motion, and transmits through the proper gearing to the burrs, which in turn convert wheat and corn into flour and meal. The entire machine could be placed in a medium-sized shoe-box, and does not exceed three hundred pounds in weight. Even this weight may be greatly reduced, as the gearing is all unnecessarily heavy. The person in charge of the car can increase the power at will, even concentrating it all on a single motor if necessary. The current reversed will serve as a brake in going down grades, and in this respect will be more effective than any other ever used.

In addition to propelling the cars by electricity, Dr. Finney has designed electric lamps for lighting them, the power to be taken from the same conductor. A company with large capital has been organized to push tha invention, and it will likely be adopted in the Union Line before long.

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IRISH RAILWAYS.

The London *Mining Journal* says: "Statistics prove that there has hitherto been a most unaccountable absence of railway and commercial enterprise in Ireland, and that there is ample room for great expansion. Proportionately to other parts of the United Kingdom the extension of the railway system in Ireland has been very small indeed. There has been no material improvement in trade and commerce, no commensurate development of its collieries or mining industries for many years past, while there is a positive decrease in population. In tha year 1801, when the union with England was effected, the population of England was 9,334,549, while last year it had increased to 25,968,286. In Ireland, in 1801, the population was 5,319,867, while last year it was only 5,159,839, so that while England has nearly trebled its population within the past 80 years, Ireland has lost nearly 200,000. This decreased population and the stagnation of trade and commerce is unquestionably due to the absence of railways and of commercial enterprise. Again, tha total length of the railways open in Ireland on Dec. 31, 1881, was only 2,370 miles, the nominal capital being only £33,741,058, the gross receipts £2,695,272, and the net revenun £1,230,635. Thus for the whole of that extensive country the total capital expended on its railways and their total revenue is scarcely one third of the amount expended and earned upon one of the great railway systems in England. The nominal capital of the London and Northwestern Railway Company is no less than £92,456 537, and its gross receipts were, in 1880, £9,827,022. The nominal capital of the Great Western is £66,693,695 and the gross receipts £7,281,329. The Midland nominal capital is £67,807,681 and the total receipts £6,771,384. Tha nominal share capital of the Northeastern is £55,187,019 and the gross receipts £6,436,852. Compared with other of our English lines, those of our sister isle would bear equally significant results. These facts prove there is ample room for almost any expansion of railways, and the outlay of English and resident capital if anything lika Government guarantee could be obtained for a fair return thereon. It might be added as an inducement to capitalists to turn their attention to Ireland for the investment, that the cost of railway work there is most moderate, owing to the almost entire absence of tunnels; that the average cost of the lines constructed was only about £16,000 per mile, while the last official returns showed that, notwithstanding tha adverse circumstances under which they labored, the dividends averaged £3 14s. 9d. per annum for the past year. The whole of tha Irish lines are exempt from the payment of Government passenger duty."

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Water for Swampscott, Mass.—This town would like to obtain a supply of water from Lynn, but it is doubtful if this can be accomplished until the source of supply is increased. The capacity of a water supply is to be determined by the year of low rainfall, as that is the contingency to be provided against. For the three years from 1879 to 1881, inclusive, with a rainfall averaging 41.54 inches, the records give the total amount of water received into the Lynn ponds at 1,389,737,618 gallons, and the amount consumed for the same period 1,380,818,523 gallons, or only 9,000,000 less than the entire supply by rainfall. This amount of water insured for the next three years will not be sufficient to supply the demand, as the city is growing, and the consumption constantly increasing. In view of these facts it is a question if Lynn can afford her neighbor any water. If Swampscott is denied a supply from this source, then she has the Swamscott Water Company to deal with, which corporation is ready to pipe the town and supply the water from its tubular-well system.

Extending its Service.—The common council of Salem, Mass., has appropriated $2,500 to extend its water-pipes.

Bids Rejected.—The water commissioners of Springfield, Mass., have rejected all the bids received for the construction of the dwelling-house at the Ludlow reservoir, none of them being low enough.

The Curtis Regulator Co., of Boston, has received an order for some large steam-traps from the Westbrook Manufacturing Co. (Cotton), it being their fifth order for Curtis traps and regulators.

Gas Lighting in Washington.—Mr. S. Calvert Ford, the inspector of gas for the district of Columbia, has submitted his annual report to the Secretary of the Interior. Ha says: The gas manufactured and supplied by the Washington company is not entirely a product from coal. They use naptha as an enricher. This hydro-carbon is converted into a fixed gas and then united with the gas obtained from coal. This combination of the gases from coal and naptha yields an illuminating gas of high specific gravity. On some occasions complaints were made of its giving off smoke. This nuisance, however, will arise from several causes, such as a scant or inadequate supply, imperfect or unsuitable burners and a deficient pressure. The gas supplied by the Georgetown company is manufactured entirely from coal with cannel coal, ten to fifteen per cent. being used as an enricher. The illuminating power of the gas supplied by the Washington company, on an average for the year, was 16.87 candles. The highest power during the year was 18.53 candles, and the lowest 14.49 candles. On eighteen occasions during the past year the gas supplied by the Washington company was of less illuminating power than sixteen candles. Tha average illuminating power of the Georgetown company was 16.94 cand'es. The highest 20.16 candles, and the lowest 13.86 candles. On twenty-eight occasions during the year the gas of the Georgetown company was less than sixteen candles. Fourteen hundred and twenty metres were inspected and proved. With the exception of 2 metres inspected and proved by the Alexandria company, the above number was inspected and proved for the Washington company and for consumers of gas. The result showed that 83 registered fast against the consumers, an average error of 3.56 per cent.; 117 slow against the companies—average error 7.21 per cent.; 1,216 within the limits allowed by law, viz., 2 per cent. either way; 51 did not register the gas flowing through them, and 1 was locked, so no inspection could be made. 220 were inspected and proved on complaint, 55 by consumers of gas; 17 registered fast—average error 4.16 per cent.; 13 slow—average error 3.96 per cent.; 25 within the limits allowed by law. 165 were complained of by the gas companies; 8 registered fast, and 91 slow; 19 within the limits allowed by law. The inspector recommends that the act of Congress regulating gas works be modified so as to require when, for any purpose whatever, the heads of meters that have been inspected, proved, and sealed, are removed by the gas companies, meters of this description should be classed as repaired meters, and brought to this office for re inspection before again being placed in service. The seal of the inspector is the evidence that the meter has been properly tested and proven, as required by law. To admit the right of the companies to remove the head of a sealed meter and rectify whatever is wrong, and return the meter to service without re-inspection and sealing, would be to render the law practically inoperative, by making uncertain, if not impossible, the protection secured through inspection and sealing by the office created for that purpose.

Portsmouth City, Va., is to have water-works, the same to be built by a private corporation. They will draw their supply from Lake Drummond, which is a distance of about 20 miles from the city. Survey nearly completed.

Investigating a Gas Company.—Richmond, Sept. 8.—Tha City Council committees on finance and light to-day appointed a sub-committee to visit Philadelphia and inquire into the financial standing of the Limited Gas Light Company, of that city. This company has a proposition pending before the Richmond Council for the lease of the gas works of this city for a period of thirty years. The sub-committee appointed will leave for Philadelphia upon that errand soon.

The rain-fall at San Antonio, Tex., during the storm on the 6th inst. amounted to six and one-fifth inches—the heaviest known there in the same space of time.

The Cambria Iron Company, Johnstown, has erected an additional water supply for their works capable of yielding 20,000,000 gallons a day.

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ELECTRICITY.

French Underground Telegraph.—An underground telegraph system between Paris and Marseilles is nearly ready for use in France. Three weeks ago 150 men were engaged in pushing forward the work from both ends, following tha main roads and the right bank of the Rhone. From a description by *Iron*, the English journal, it appears that the pipes are laid at a depth of more than a metre and a half, and chambers for facilitating repairs are placed at about every 500 metres; they resemble large cast-iron caldrons with covers, and have apertures for receiving the ends of the two pipes which they connect. Every 100 metres the pipes are united by cast-iron couplings, which will permit of inspecting and repairing the cable, and the joint between each pipe is mada with an india-rubber washer or lead collar. "The work is pushed forward with vigor," adds the same paper, "and it is proposed eventually to connect this cable, which will traverse France from north to south, with the cables of the Mediterranean and Atlantic."

Electric Railway.—There are now in operation in Europe about one hundred miles of electrical railways, and numerous others are projected. Those in operation include one at Lichterfelde and that from the Spandauer Rock to Charlottenberg, near Berlin; another from Port Rush to Bush Mills, in the north of Ireland; and in Holland, from Zandvoort to Kostverloren. Among lines in construction are: In Austria, the Moedling line, near Vienna; in Germany, from Wiesbaden to Nurnberg, and from the royal mines of Saxony to Zankerode; in England, under the Thames, connecting Charing Cross and Waterloo stations; also in South Wales, for which the force will be derived from the fall of water. In Italy, Turin and Milan will soon begin the construction of electric roads.

Dr. Siemens, President of the British Association, is certain that the steam engine is doomed. Its fate is first to be confined to the driving of large dynamo machines, which will distribute force at present supplied by a myriad small and wasteful steam engines, and then to be superseded altogether by the gas engine. Gas and electricity may be mutually hostile, but they are to unite their forces in order to extirpate the steam engine on account of the wastefulness of the latter in the consumption of fuel.

STREETS, DRAINAGE, ETC.

THE COMMITTEE on SEWERS, of Boston, want an additional appropriation of $51,416 to complete the work of the year. The appropriation for the present financial year was $200,000, of which $140,416 has been expended; to finish contracts already in progress will require $34 000; to build sewers already ordered by the Board of Aldermen, $17,000; to build sewers petitioned for and not ordered, $12,000; for running expenses of department, with the usual amount of repairs, etc., $48,000.——The Committee on the Stony Brook sewer will ask for an additional appropriation of $20,000 to finish the job, which was estimated would cost $130,000, but upon which $180,000 has already been expended.

SEWERAGE OF WATERBURY, CONN.—The Sewer Commissioners recommend to the Common Council a complete sewerage system for the city, planned by Civil Engineer Rudolph Hering, of Philadelphia, and costing some $78,830. Engineer Eliot C. Clark, of Boston, has also looked over the city and made a report. The Common Council will act on the reports at its next meeting. The Council has appropriated $5,000 to secure the Gamewell fire system and provided for the appointment of a fire marshal.

PROPOSALS for improving certain streets of Washington, D. C., will be received by Major G. J. Lydecker until Sept. 19.

RIVERS AND HARBORS.

THE MISSISSIPPI RIVER LEVEES AND JETTIES.—The bill passed by Congress appointing a special committee to investigate and report upon the Mississippi River levee and jetty systems, appropriated $5,000 to defray the expenses of the committee; but, by an oversight on the part of the framers of the measure, made the amount available after the presentation of vouchers covering the expenses of the committee. The committee is to meet at Cairo, Ill., on November 10, and in order to obviate any inconvenience to its members, and to insure their meeting on the day indicated, Sergeant-at-Arms Hooker has placed $5,000 out of his own personal fund to their credit.

RAILROADS.

SILVER CITY, DEMING AND PACIFIC RAILROAD COMPANY.—This company has recently been incorporated under the laws of New Mexico, designed to connect at Deming with the Atchison, Topeka & Santa Fe, Southern Pacific and Texas Pacific railroads. The road was organized by prominent bankers and merchants of Grant County, who have raised all the necessary funds, and the road is now being graded to Silver City, forty-five miles west of Deming. The road is broad-gauge, but the intention is to connect the road at Silver City with narrow gauge branches to Santa Rita, Fort Bayard, Georgetown and the Moggalon, Lake Valley mines and the Clifton mines. It is designed by the present company to build next year narrow-gauge branch roads to Santa Rita and Georgetown, and to the Clifton copper-mining district in Arizona.

A PRELIMINARY survey has just been started for a narrow-gauge railway from Norfolk, Va., to The Hollies (a proposed watering-place on the Atlantic Ocean beach, five miles from Cape Henry Light down the coast). It is proposed to advance the construction as soon as the survey is completed. The line will be about twenty miles long.

WORK ON A MAINE ROAD.—Track is now lain on the Bangor & Katahdin Iron Works Railroad to Foster Brook, Me., 10½ miles northward from the late terminus at Brownville, and 16½ miles from the Bangor & Piscataquis road at Milo. About three miles are to be laid to reach the Katahdin Iron Works.

WEAR OF RAILS.—The Great Central Belgian Railroad has prepared some elaborate statistics as to the wear and tear of rails upon its system. It appears that after twelve years' service only 38 per cent. of the steel rails laid down upon its system in 1869 had been withdrawn in 1881. On the other hand, the proportion of the iron rails laid down in 1869 and withdrawn in 1880 was 95.74 per cent. of the whole number employed. Since the organization of the Great Central Belgian Railroad Company in 1865, it has employed 79,116 tons of rails, of which 67,569 tons were iron rails, and 11,547 tons steel rails. Of the iron rails laid down, 31,847 tons have been replaced, while of the steel rails laid down only three tons have been replaced.

THE mileage of new railroads completed last week was 124 miles, making 6,668 miles thus far this year, against 4,018 miles reported at the corresponding time in 1881, 3,196 miles in 1880, 1,798 miles in 1879, 1,160 miles in 1878, 1,176 miles in 1877, 1,467 miles in 1876, 702 miles in 1875, 1,008 miles in 1874, 2,455 miles in 1873, and 4,498 miles in 1872.

NEW YORK, Sept. 13.—To-day the track of the Mexican National Railway is laid 102 miles out of the City of Mexico; 170 miles from Laredo to Monterey; and something over 7 at Manzanillo—in all 279 miles built under the main concession. This completes the "450 kilometres" stipulated in the main concession to be finished within two years from the beginning of construction. This term of two years does not expire until Oct. 14, 1882. We have built in Mexico now, under other concessions, 74 miles additional, making our mileage already constructed in Mexico 353. The Texas Mexican lines extend 179 miles, making the total constructed mileage of the company to date 532 miles.

A FLORIDA SCHEME.—A railroad is to be built connecting Jacksonville, Fla., with the seaside. The road is to be 13 miles in length, narrow gauge, and is to cost $100,000. It will be called the Arlington & Atlantic Railroad.

TRACKLAYING is progressing on the Swedesboro' Extension, N. J., ½ mile per day.

THE work of double-tracking the Cincinnati, Hamilton & Dayton Railroad has commenced at Schenck's Station, working to Lockland, and when completed will be a continuous double track from Cincinnati to Hamilton.

LOCOMOTIVES FOR NARROW GAUGES.—The narrow-gauge people are still striving for greater tractive power. As the traffic increases their resources are severely taxed, and, burdened as they are with small cars, they find that long trains are necessary, and, consequently, to get power to do the work, unusually heavy engines are needed. As they are usually limited by their very light rails, the weight on each driver has to be kept down. Consequently, even for passenger work, they have had to resort to "moguls," and "consolidations" are commonly used for freight. One of the latest of these engines, built by the Baldwin Locomotive Works, has 10 drivers, an overhanging fire-box back of the drivers, cylinders 16 in. in diameter by 20 in. stroke, 37-in. driving-wheels, and a total wheel-base of 15 ft. 5 in. The rigid wheel-base is 9 ft. 9 in. The boiler, which is intended to burn wood, is 52 in. in diameter, with flues 13 ft. ⅝ in. long, and a fire-box 48½ in. long, 48 in. wide and 54½ in. deep. These engines are very light on the rails, the great number of driving-wheels giving the necessary adhesion without excessive weight upon any one pair.

EXTENSION OF THE C. & O. COMPLETED.—The extension of the Chesapeake & Ohio Railroad from Newport News to Fortress Monroe, Va., has been finished. Through trains to the West will be put on about Oct. 1.

RAILWAY EXTENSION.—The Montreal, Portland and Boston Railway is now completed from West Farnham, Que., to East Franklin, Vt. The road will soon be completed to Sheldon. A dispatch from Canton, O., says that the Coshocton and and Straitsville extension of the Connotton Valley Railroad is now completed to the Cleveland, Tuscarawas Valley and Wheeling Railroad crossing, eighteen miles south of Canton. The work will progress southward as fast as money and men will permit. The Utah division of the Denver and Rio Grande Railway is completed to Montrose, on the Uncompahgre River, 352 miles from Denver. The link necessary to connect the Colorado and Utah systems is now reduced to 275 miles. The New Orleans division of the Texas and Pacific Railway will be opened to-day. The road has been in operation since last Spring from Marshall to Cheneyville, and at the latter place it connected with the Morgan's, Louisiana and Texas Railroad. The road runs from Shreveport to New Orleans, a length of 350 miles. The Danville, Olney and Ohio River Railroad Company celebrated the completion of the northern division of their road from Danville to Olney by running an excursion train over their road on the 23d ult. The Wisconsin Central's new line from Neenah to Oshkosh will be finished to-day. It is expected that the entire new line to Milwaukee will be finished by the close of the present month.

THE NORTHERN PACIFIC AND THE WISCONSIN CENTRAL.—It is reported that an arrangement has been made between the Wisconsin Central and the Northern Pacific for the building of a road from Superior City to Ashland. The Northern Pacific is finished from Thompson, at the head of the St. Louis Rapids to Superior City, and that portion of the road has been accepted by the government. It is the general opinion that it would be best for the Northern Pacific to buy the Wisconsin Central, and then, by an arrangement with one of the Milwaukee roads, or the building of 85 miles of new road, the trains could be made up in Chicago to run through to Puget's Sound. It is believed that this will be ultimately accomplished.

THE Fort Worth and Denver City Railway was completed to Wichita Falls, the terminus of its first division, 110 miles from Fort Worth, Tex. Through trains will be run in a few days.

PEMIGEWASSET VALLEY RAILROAD.—The first regular track-laying on the new Pemigewasset Valley Railroad began at Plymouth, N. H., on Monday, at the junction with the Boston, Concord & Montreal Railroad. Robert Caldwell, of Sheldon, Vt., contractor, has 17 men at work, and more are coming. The 20 miles to be laid to Woodstock will be finished about Nov. 1. Nearly all the grading, bridges, etc., are now done.

CHICAGO'S STREET RAILWAY.—CHICAGO, Sept. 12.—Judge Gardner rendered a decision to-day in the case of the use of the streets by the South Side Horse Railway Company by cars propelled by cable, which in turn is moved by steam. The application was for an injunction to prohibit the company from the use of the cable under its charter as a "horse railway" company. The court practically decided the whole case by holding that the proper designation of the road was a "street railway." The power and jurisdiction of the City Council over the streets, and over their use and occupancy, and over the question as to how vehicles may be propelled upon them, whether by steam or otherwise, was held to be unquestionable. The City Council having granted the right to use the cable, which was moved by steam, the authority of the street railway company could not be restrained in the manner sought. The injunction was therefore refused. Practically, therefore, the horse railway or street railway question is in the control and discretion of the City Council, subject only to such restrictions and limitations as may be contained in the general character of the city and in the special charters of companies. Within the limits of the company's charter and the contracts hitherto made, the City Council has as complete control over those railways as it has over any other matters of city legislation.

CONTRACTS LET.

RAILROAD CONTRACT LET.—OTTAWA, Ont., Sept. 13.—E. A. C. Pew has completed his arrangements and signed a contract with the Souris & Rocky Mountain Railway Company to build their line from a point on the Canada Pacific Railway 100 miles west of Winnipeg to the Rocky Mountains. Mr. Pew has also purchased a controlling interest in the company. The Souris & Rocky Mountain Railway runs in a northwesterly direction through Rapid City, Fort Ellice, Battleford and Edmonton.

CONTRACTS LET FOR REPAIRING.

HOUSE OF CORRECTION, CAMBRIDGE, MASS.—The contract for repairs at the house of correction, which include the erection of several new buildings, has been awarded to J. H. Coon, of Boston for $60,926. The highest bid was $82,788, and the price does not include the cost of excavating, placing of stone work, boilers, etc. By the terms of the contract the walls at the east of the hospital are to be removed, and there will be built a boiler house and stable in one building, 37x68 ft.; the brick building known as "Bummers' Hall," the old chimney, stable, boiler-room and wall on Spring st., are to be torn down, and an addition to the present prison 46x57 ft. is to be constructed. This will contain a block of 110 cells, an entrance 28x52 ft., and be three stories in hight. There is also to be an extension of the workshops 42x44 ft. and three stories high. One fourth of the division walls, between the old cells in the cell-block on Third st., are to be removed and new ones constructed; there will also be new doors to the cells much better than those at present used, and there will be much better light in the corridors than now. The work is to be completed by Jan. 1, 1883.

CANALS.

THE PANAMA CANAL PROJECT—LONDON, Sept. 8.—A dispatch from Paris says: "The subscription for the Panama Canal Company of 250,000 bonds of 500 francs each is considered a success.

BUILDING.

PROPOSALS FOR TWO HUNDRED HOUSES.—R. M. Kennedy, of Second and Wood streets, Pittsburgh, Pa., will receive proposals for designs and building 200 frame houses of from three to eight rooms each.

BUILDING SITES APPROVED.—The Secretary of the Treasury has approved the recommendation of the commission on the selection of a site for the location of a public building at Minneapolis. He has also approved the site selected for the public building at Detroit, in so far as concerns the offer of Mr. Joys to sell his lot adjoining the present post-office property for $26,000. The owner of the other lot selected for the extension has been notified that his terms of sale ($34,000) are too high, and that unless he will accept a lower figure for his property it will be secured by condemnation.

THE Watertown (Mass.) Public Library contract has been given to David Perkins, carpenter, of Boston, who will take charge of the sub-contracts and be held responsible for a satisfactory completion of the entire structure, including the heating apparatus, but not the bookcases and furnishings, the price being $96,548. Messrs. G. R. and R. G. Shaw, of Boston, are the architects.

WORKS are to be erected in Wilmington, N. C., by New York and foreign capitalists to treat sulphuretted gold ores.

BRIDGES.

BRIDGING THE HUDSON.—Plans have been commenced by the officers of the New York and New England Railroad, and other capitalists, on a bridge to cross the Hudson at Newburgh, N. Y.

WORK ON THE EAST SYRACUSE BRIDGE.—There are about 150 masons and stone cutters at work on the big bridge of the West Shore railroad near East Syracuse, N. Y.

A BRIDGE that is warranted to support a strain—a bridge of a fiddle.

COFRODE & SAYLOR are building the Atchafalaya bridge for the Texas Pacific Railroad Company. The structure will be 800 ft. long, with two spans of 250 ft. each, and one draw span of 300 ft., to be operated by an engine. The work of constructing the Monongahela River bridge, 5,400 ft. in length, has been commenced. It will be the longest iron bridge in the United States.

THE McKeesport Youghiogheny Bridge Co. has been authorized to own and maintain a bridge over the Youghiogheny River at McKeesport, Pa., and will soon be ready to let contracts for the work.

THE Louisville Bridge Co. is putting up an iron bridge of 125 ft. span at Shoal River, Fla., on the Pensacola & Atlantic road. It will be 1,400 ft. long.

THE Keystone Bridge Co., at Pittsburgh, has the contract for the new bridge over the Ohio at Point Pleasant, W. Va., for the Ohio Central road.

THE Patapsco Bridge & Iron Works of Wendell Bollman in Baltimore are building several bridges for the West Virginia Central & Pittsburgh road. They have also a good deal of roof and building work on hand.

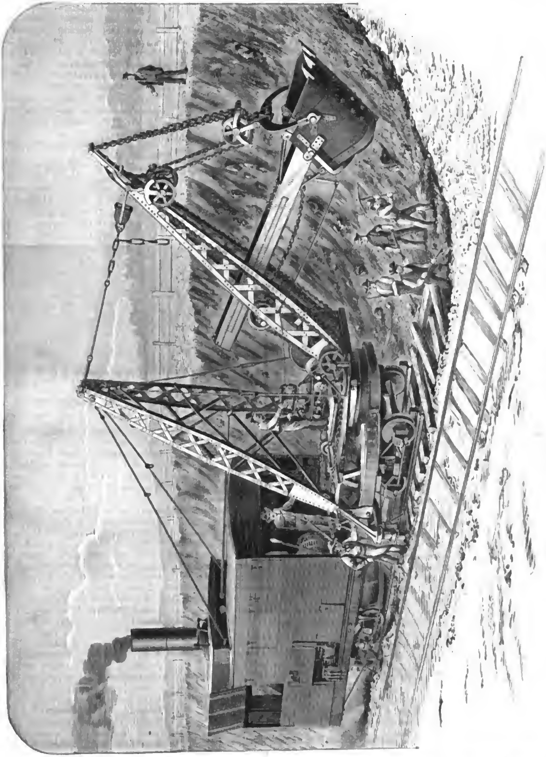
MISCELLANEOUS.

A FORTY-NINE TON FLY-WHEEL.—The largest fly-wheel of a stationary engine ever constructed in the United States was completed by Watts & Campbell, Newark, for Clark's Thread Works, in the same city. The wheel is built in seven sections, each weighing seven tons. It is twenty-five feet in diameter and its "face" is seven feet six inches. It has three crowns on which three twenty-four-inch belts run. The lathe was two weeks running, night and day, in turning off the face of the monster wheel, and five tons of chips were planed from the surface. It took 5 minutes 55 seconds for the wheel to make one revolution on the lathe. The total weight of the wheel is forty-nine tons.

THE WRECKED STEAMER NANKIN.—Colonel Gillespie, on the 14th, opened the four bids which had been received at the Army Building for raising the wreck of the English steamer Nankin. The contract was awarded to Mr. Samuel R. Cummings at $24,749, the lowest bid. The Nankin was sunk in the Swash Channel by a collision with the steamer George W. Clyde on April 28, and is now broken in two parts. The wreck was sold at auction to C. R. Harrick, who subsequently transferred it to Mr. W. E. Chapman, of No. 75 South street. Mr. Chapman claims that the wreck is his property and that he is using all diligence in removing it, and therefore protests against the government's action.

STEAM EXCAVATOR AND DUMPING CAR.

The accompanying engraving represents a combined excavator and dumping car built by the firm of Osgood & MacNaughton, 37 State street, Albany, N. Y., for use on the West Shore Railroad, and is so clear as to need but a brief description. It is particularly adapted for all building operations when it is desired to move large quantities of materials quickly and cheaply. The machinery is placed on a platform car, advanced on rails laid as the work progresses. In transportation the **A** frame is hinged at the lower end, so that it, together with the boom, can be lowered until it rests on an ordinary car placed in front, thus permitting of the passage under bridges. The weight of the machinery when at work is removed from its car, and is supported by a hydraulic-jack capable of supporting a load of 1,000 pounds to the square inch. The dipper has a capacity of 2 cubic yards, weight 3,000 pounds, and is built of steel, after the "Osgood" pattern. It is operated by a pair of engines geared to drums carrying the two separate hoisting chains, which accomplish the swinging without the help of other machines. The engine cylinders are 10 by 12 in. The operation of forcing the dipper into the bank is accomplished by two engines, 6¼ by 10 in., which are placed on the turntable. As these are reversing engines, complete control of the dipper is obtained both in depositing the load and holding it to the work. The boom is hinged to the turntable, and so connected with the **A** frame that it can be given the inclination to the work best suited for the purpose. A powerful spring being placed in the chain from the frame to the boom the destructive jars transmitted from the dipper to the machinery are much lessened. For use as a derrick the dipper and dipper handle are removed—an operation of but a few moments—when the machine is ready for any work suitable to a derrick. Approved friction clutches are used in all case instead of positive clutches, which are frequent causes of trouble. This machine has been in use for some time on the West Shore road, in a species of hard pan, which would otherwise have required blasting to loosen it. Notwithstanding the exceptional hard work to which it has been subjected no sign of weakness or rupture in any of its parts has appeared. Built upon sound principles, and of the best materials, it has far surpassed the expectations of all parties.



OSGOOD & MACNAUGHTON'S STEAM EXCAVATOR AND DUMPING CAR.

PROPOSALS FOR IRON BRIDGE.

On the 20th inst. proposals were received by Chas. E. Fowler, City Engineer of New Haven, for the construction of an iron bridge and abutments over the tracks of the N. Y., N. H. & H. R. R., at the Lamberton street crossing.

SUPERSTRUCTURE.

Corrugated Metal Co., East Berlin, Conn....	$18,300.00
King Iron Bridge & Manfg. Co., Cleveland, O.	17,907.00
Boston Bridge Works, Boston, Mass....	17,800.00
L. W. Dinsmore, Hillsboro Bridge, N. H....	17,648.00
Hudson River Bridge Works, Hudson, N. Y.	16,756.00
Wrought-Iron Bridge Co., Canton, O... ...	16,800.00
Morse Bridge Co., Youngstown, O..........	15,400.00
Wallis Iron Works, Jersey City, N. J.......	13,437.00
Penn Bridge Works, Beaver Falls, Penn.....	12,848.00

The contract was awarded to the Penn Bridge Works.

SUBSTRUCTURE.

Peter Small, New Haven, Conn...............	$18,467.00
Robert Redfield, New Haven, Conn..........	15,600.00

The contract awarded to Robert Redfield.

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PROPOSALS FOR ORANGE (N. J.) WATER-WORKS.

On August 28 last proposals were opened by the Common Council of the city of Orange, for the following work and materials:

The building of a dam, with flume, 2 gate houses, and all necessary or proper appurtenances; the laying of about 26 miles of pipe; the setting of hydrants and other fixtures; 41,311 cubic yards of embankment; 2,220 cubic yards of rubble masonry; 1,000 cubic yards of ashlar masonry; the clearing of 40 acres of land, together with all necessary excavation and labor therefor.

MATERIALS.

66,520 lineal feet of 4-inch pipe.
42,150 " " 6-inch "
27,375 " " 8-inch "
9,660 " " 10-inch "
7,900 " " 12-inch "
31,680 " " 16-inch "
360 " " 20-inch "
2 20-inch gates, flanged.
6 16-inch " hub.
8 10-inch " " (1 flanged).
15 8-inch " "
25 6-inch " "
60 4-inch " "
200 double nozzle hydrants.
112 gate boxes.

—— special castings, such as valves, boxes, covers, screws, rods, etc., as the same may be designed and ordered by the Engineer of the city, from time to time.

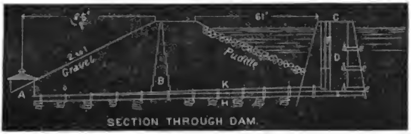
—— barrels of American Hydraulic cement, of the best quality, freshly ground.

The works will be built on the gravity system, the reservoir being located in a valley between the first and second mountains at a distance of about 6 miles from the city. The water-shed covers an area of about 5 square miles. The reservoir will cover about 60 acres and will be irregular in shape. The dam across its lower extremity will be 875 ft. in length and 40 ft. in height at the center. The mountains form the borders of the remaining sides of the reservoir. All the water carried by a stream flowing between the mountains will be utilized. The average computed supply to be obtained from all sources (rainfall calculated at only 12 in. per annum) will be about 3,000,000 gallons per day, amply sufficient for some time for a place whose present population is 13,000. A pressure of 142 pounds will be obtained at the hydrants, sufficient for fire purposes.

The dam will be built upon a suitable foundation, and there will be three ditches 8 ft. wide and 3 ft. deep under the whole length of the embankment and filled with selected puddle. The dam will be built of cemented masonry, and puddled gravel and clay. The slope of the up-stream side will be 2½ horizontal to 1 vertical, and of the lower side 2 horizontal to 1 vertical. The top of the embankment will be 20 ft. wide. Throughout the entire length of the embankment there will be a wall of first-class cemented rubble masonry. Above the upper slope there will be a rectangular flume and gate-house to receive screens, gates, charcoal, etc. Below there will be a gate-house for the waste water and conduits, gates, etc. From the cross-section drawing, which we herewith present, an accurate idea may be obtained of the plan of the dam, gate-houses and flume.

The flume is rectangular in section, and upon the side at which the water enters will have valves or gates for admitting the supply. These are arranged in a vertical line, in order that the water from the basin may be drawn from any depth below the surface. This arrangement is made necessary by the fact that the depth of the purest water to be obtained from a reservoir at the different seasons of the year varies. Practically the flume will be divided into two sections the entering water will pass through a bed of charcoal to clean it of all sedimentary matters; it will then pass through sponges, as shown in the drawing, before entering the general supply pipe. These sponges will be held in place by a perforated division of copper. These sponges will absorb all animal organisms, and when in combination with the charcoal will purify the water as thoroughly as it is possible for a filter to do. From the flume to the gate-house are two sets of conduits and the connections are so made at the house that the supply pipe can be opened for cleansing purposes without interfering with the water going to the city.

The dimensions and shape of the rubble masonry extending through the embankment are clearly shown in the drawing.



A = Gate-house.
B = Wall of cemented gravel.
C = Flume.
D = Charcoal filter.
e = Inlet pipes
F = Sponges.
H = Waste pipe.
K = Conduit pipe.
Rip-rap has a batter of 2½ to 1.

The masonry for the flume and gate-houses will be of ashlar well bonded and grouted and rendered water-tight. The specifications state that all stones used in any part of the masonry must be washed and cleaned of dirt before being laid. Also all heavy pounding and jarring on the wall are to be avoided.

The cement used will be the American hydraulic mixed in the proportion of one cement to two of clean, sharp sand.

The pipes to be of strong, tough gray remelted pig-iron, which will permit of its being readily drilled or cut. Their length not to exceed 12 ft., nor to be less than 11.75, in length, when laid. All pipes and castings to have a groove in the bell ⅜ of an inch wide and $\frac{3}{16}$ of an inch deep, so as to allow room for lead in the joints. The pipes are to weigh as follows, and no deviation of more than 5 per cent. to be allowed:

Per head.		Per length or 11.8 ft.	Per length 12 ft.
100 a....	20-in. pipe, 134 ft....	1,608	1,635
150 b....	16-in. "	1,258	1,274
200 c....	16-in. "	1,360	1,385
200......	16-in. "	1,463	1,487
	12-in. "	944	960
	10-in. "	723	735
	8-in. "	529	535
	6-in. "	361	367
	4-in. "	218	222

The dimensions of rock trenches to be as follows at the bottom:

For 4 and 6 in. pipe, 1½ ft. wide.
For 8 and 10 in. pipe, 2 ft. wide.
For 12 and 15 in. pipe, 2¼ ft. wide.
For 16-in. pipe, 2½ ft. wide.

The hydrants will be so located that each will cover an area of a radius of 250. Gates will be provided so that any portion of the city can be shut off for repairs or other purposes without interfering with the general supply.

The works were designed and are now in charge of William B. Rider, who built the water-works at South Norwalk, Wolcottville, Bethel, Thomaston, Kent and Greenwich, Conn., and at Walton and Oneonta, N. Y., and who is now in charge of the works building at Hornellsville, N. Y.

A committee composed of Horatio Allen, I. S. Cassin and George H. Cook, appointed to consider the proposed plan of William B. Rider, reported that the supply would be adequate for all needs of the city. "The storage reservoir is planned to hold at least 250 million gallons, and a moderate expense may, if ever found necessary, be increased to a capacity of over 300 million gallons. This quantity of itself is sufficient to give the supply now needed for 320 days."

The pressure was considered amply sufficient for fire and domestic purposes.

The plan of Mr. Rider for an auxiliary high pressure reservoir was considered perfectly practicable, and it can at any time be cheaply and effectively constructed.

The quality of the water was deemed unexceptionable.

Upon our visit to Orange, a few days since, we received much valuable information from Mr. Rider, and a tabulated statement of the bids received which we herewith append.

To the kind courtesy of City Clerk of Orange, Mr. Horace Stetson, we are indebted for the following list of contractors with the gross amounts and for the list of the successful bidders.

Laying Pipe and Rock Excavation in Trenches.

Geo. H. Titcomb (does not include Rock), 23 Whitehall St., N. Y................	93,331.75
John Satterlee & Co. (does not include Rock), Gloster, N. J..................	86,529.90
John Mullen, (Macadam streets 6 cts. extra), Orange, N. J..................	74,826.85
Myles Tierney, Jersey City, N. J....... .	72,039.00
Williams & Hallinan (does not include Rock, nor 16-in. pipe), Chicago, Ill....	69,588.75
John W. Rutherford, Hoboken, N. J....	67,804.75
John Lockwood & Co. (see bid), New York................................	67,638.90
J. J. Newman & Co., Providence, R. I...	66,098.10
John E. Halliday, Jersey City, N. J. ...	65,015.80
John O'Rourke, Orange, N. J............	63,704.10
George B. Inman, New York............	60,899.30
Freel & McNamee, Brooklyn, N. Y......	59,918.60
H. N. P. Dole & Co., Columbus, O......	57,231.50
Francis Leonard & Co. (does not include Rock; Macadam; 10 cts. extra), Norwalk, Ct........	56,406.06
Henry Lewis, Flushing, N. Y...........	54,808.25
Frank C. O'Reilly, Orange, N. J........	54,333.55
William H. Weldon, Lamington, N. J., (bid informal)......................	52,316.25
John M. Weldon, Rahway, N. J., (bid informal)................;...	49,963.40

Dam (exclusive of Timber & Rock excavation).

George H. Titcomb, New York.........	84,732.48
J. J. Newman & Co., Providence, R. I.	72,513.15
John Mullen, Orange, N. J.............	71,080.32
Fred'k W. Morris, Orange, N. J........	46,658.50
John W. Rutherford, Hoboken, N. J...	46,273.17
Myles Tierney, Jersey City, N. J.......	45,678.95
John Satterlee & Co., Gloster, N. J.....	45,009.95
John O'Rourke, Orange, N. J...........	43,872.14
George B. Inman, New York..........	41,257.40

BIDS FOR MATERIALS AND WORK ON THE ORANGE (N. J.) WATER-WORKS.

Name of Contractor.	Residence.	Cast-iron pipe, ton of 2,240 lbs.	Specials per lb.	Hydrants. With case. 6-inch	Hydrants. With case. 4-inch	Hydrants. Without. 6 inch	Hydrants. Without. 4-inch	Gates. 20-inch flange	Gates. 16-inch	Gates. 12-inch	Gates. 10-inch	Gates. 8-inch	Gates. 6-inch	Gates. 4-inch	Pipe Laying. 20-inch	Pipe Laying. 16-inch	Pipe Laying. 12-inch	Pipe Laying. 10-inch	Pipe Laying. 8-inch	Pipe Laying. 6-inch	Pipe Laying. 4-inch	Excavation. Rock	Excavation. Earth	Puddle and dry embankment	Masonry per cu. yd. Rubble	Masonry per cu. yd. Ashlar	Clearing, per acre	Gate Boxes, each	Paving per yard	Timber per M	Wrought Iron	Cement per bbl.
		$	Cts.	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	Cts.	Cts.	$	Cts.	Cts.	$	$	$	$	$	$	Cts.	$
Treman, Waterman & Co.	Ithaca					33.00	25.00																									
John W. Rutherford	Hoboken														.90	.80	.50	.40	.35	25	20	3.00	35	47	4.10	15.00	35.00		2.50	48.00		
Freel & McNamee	Brooklyn														.80	.70	.36	.31	.26	23	20	5.00	30	30	5.25	7.00	50.00		.30	30.00		
Richard Pancoast	Orange	37.50	3½	40.00	32.65	44.10	28.95	175.00	89.50	52.00	40.00	27.25	18.56	12.17	Hydrants and Gates to be Chapman Patent.																	
Ludlow Mfg. Co.	Troy			17.50	33.25	42.00	28.00	120.00	80.00	50.00	38.25	28.90	18.50	11.25																		
Geo. B. Inman	New York City			40.00	35.00										1.00	.60	.47	.36	.30	26	21	4.00	1.00	40	5.00	9.00	90.00	10.00	.75	20.00	10	1.40
A. H. McNeal	Burlington, N. J	39.50	8½																													
Geo. H. Titcomb	New York City			85.00	70.00			450.00	300.00	120.00	94.00	75.00	63.00	45.00	1.35	.95	.68	.60	.45	38	35	1.55	.28	68	15.00	19.50	50.00	12.00	3.75	65.00	12	1.75
Warren Fdy & Mach. Co.	New York City	35.50	for 20-in., 16-in., and 12-in.; $36.20 for 10-in., and 8-in.; $37.25 for 6-in. and 4-in.																													
J. E. Halladay	Jersey City			Setting hydrants $5.00 each; setting gate boxes free if measured in pipe.											.67	.69	.44	.38	.32	26	23	2.50										
Miles Tiernay	Jersey City														.90	.70	.50	.40	.40	30	25	5.00	.30	45	4.75	15.00	50.00		1.00	40.00		
F. W. Harris	Orange																						.50	50	6.00	17.00			.75			
McRitchie & Nichol	Chicago			46.00	35.00			125.00	95.00	55.00	43.00	30.00	20.00	12.50	2.90	2.65	1.80	1.42	1.10	83	65	3.00	.25		6.00	12.00	60.00	6.00	2.00	15.00		
Theo. Mackuet & Co.	Newark							For all gates (Eddy make), and Bailey hydrants $8,830.35.																								
Julius Jonson & Co.	New York City			50.00	37.50			115.00	80.00	45.00	39.75	32.75	19.25	13.00														5.00				
John Mullen	Orange							For Macadam streets 6c. per lineal foot extra.							1.05	.95	.37	.33	.31	27	24	1.60	.40	38	9.00	20.00	45.00		.85			
F. C. O'Reilly	Orange														.58	.48	.40	.34	.29	24	21	1.40	.40	46	4.85	8.00	20.00		.94	40.00		
Florence Iron Works	R. D. Wood & Co., Phila	38.00	72.80	40.00	35.00			125.00	95.00	55.00	43.00	30.00	20.00	12.50														6.00				
John Watchman	Orange																										49.50					
John O'Rouke	Orange														.75	.60	.50	.42	.34	28	22	2.25	.25	42	4.40	14.00	27.50		10.00			
John M. Weldon	Rahway														.38	.34	.33	.31½	.30	28	26											
Williams & Hallinan*	Chicago														1.50½	.58	.45	.37	.33	26	23	3.00	.30	37	4.10	8.20	25.00		2.00	30.00		
Wm. H. Weldon	Lamington, N. J														.90	.50	.40	.25	.25	25	20											
John Satterlee	Gloster, N. J														.75	.65	.57	.51	.46	42	30	3.90	.25	45	6.95	8.95	30.00		1.50	60.00		
H. N. P. Dole & Co.	Columbus, O														.90	.60	.45	.35	.28	23	20	1.00										
J. J. Newman & Co.	Providence, R. I														.80	.69	.43	.38	.32	29	23	2.00	.65	65	7.00	25.00	100.00		1.50	50.00		
Henry Lewis	Flushing, L. I		All pipes in Macadam streets 6c. per ft. extra, except 4 in. which is 7c. extra.												1.00	.45	.33	.29	.25	21	18	2.50										
Hutchinson & Alexander	Allegheny, Pa			45.00	32.60			150.00	98.00	51.00	37.00	24.00	16.00	11.00																		
Eddy Valve Co.	Waterford, N. Y.					43.00	26.00	144.00	89.00	48.00	36.00	27.00	18.50	11.25																		
R. A. Brick	New York City	35.50 36.00	For all 12-in., 10-in. and 8-in. " " 6-in. and 4-in.																													
do.	do.		65.00																													
Boston Machine Co.	Boston			50.00	36.00			180.00	112.00	58.00	48.00	30.00	22.00	13.00																		
Tamaqua Iron Works	Tamaqua, Pa					29.00	27.50																									
John Lockwood & Co.	New York City														.75	.65	.55	.43	.36	29	23	3.00										
I. S. Cassin & Co.	Philadelphia		69.41	42.00	34.20			168.75	80.30	43.80	35.22	24.64	17.00	10.95																		
F. Leonard	Norwalk, Conn							for all Macadam streets 10c. per ft. extra							.65	.55	.42	.33	.25	23	20		.40	42	5.00	7.00		5.00	.40	18.00		
Burnett & Teed	Orange		Offer to clean ground and have the wood for $1,300; all wood removed to cost $1.50 per cord: brush burnt on ground; work done as per specifications.																													

* 20-in. pipe, 50-ft. head, $62.25; 16-in. pipe, 100-ft. head, $58.60; 16-in. pipe, 150-ft. head, $54.00; 16-in. pipe, 200-ft. head, $48.00; 16-in. pipe, 50-ft. head, 59.60; special castings, $60.00; 12-in. pipe, $50.10; 10-in. pipe, 51.04; 8-in. pipe, $54.07; 6-in. pipe, $55.85; 4-in. pipe, $65.86 per ton of 2,240 lbs.

Frank C. O'Reilly, Orange, N. J.	39,267.42
Francis Leonard & Co., Norwalk, Ct., (don't include clearing land)	35,997.23
Williams & Hallanan, Chicago, Ill.	34,685.07
Freel & McNamee, Brooklyn, N. Y.	33,891.50

Puddle-Bank.

John Mullin, Orange, N. J	0.85

Setting Hydrants.

John E. Halliday, Jersey City, N. J. (each)	5.00

Clearing Land.

Burnett & Teed, besides wood	1,300.00

Timber, per M.

Geo. H. Titcomb	70.00
John Satterlee & Co	60.00
J. J. Newman & Co	50.00
John Rutherford & Co	48.00
Myles Tierney	40.00
Francis C. O'Reilly	40.00
Freel & McNamee	30.00
Williams & Hallinan	30.00
George B. Inman	20.00
Francis Leonard & Co	18.00
McRitchie & Nichol	15.00

Rock Excavation at Dam.

George B. Inman	$1.00
John W. Rutherford	3.00
Freel & McNamee	3.00
Myles Tierney	3.00
Williams & Hallinan	3.00
J. J. Newman & Co	2.00
John O'Rourke	1.87½
John Mullen	1.60
George H. Titcomb	1.55
Francis C. O'Reilly	1.40

Pipe and Special Castings.

George B. Inman, N. Y	158,254.44
A. H. McNeal, Burlington, N. J	158,254.44
Florence Iron Works, Florence, N. J	152,602.27
Richard Pancoast, Orange, N. J	150,473.69
Warren Foundry Machine Co., Phillipsburgh, N. J	145,128.88
R. A. Brick, New York (don't include 20 in. and 16 in. pipe)	75,176.82
Williams & Hallinan, Chicago, Ill. (bid informal)	

Gates.

George H. Titcomb, New York	8,998.00
Theo. Macknet & Co., Newark, N. J	8,926.35
Boston Machine Co., Boston, Mass	3,264.00
McRitchie & Nichol, Chicago, Ill	2,933.00
Florence Iron Works, Florence, N. J	2,983.00
Richard Pancoast, Orange, N. J	2,880.85
Julius Jonson & Co., New York	2,832.00
George B. Inman, New York	2,750.00
Eddy Valve Co., Waterford, N. Y	2,712.50
Ludlow Valve M'f'g Co., Troy, N. Y	2,884.00
Hutchinson & Alexander, Alleghany, Pa.	2,669.00
I. S. Cassin & Co., Philadelphia, Pa	2,602.22

Hydrants, with Frost Cases.

Julius Jonson & Co., New York	$7,625.00
Boston Machine Co., Boston, Mass	7,340.00
I. S. Cassin & Co., Philadelphia, Pa	6,918.00
Richard Pancoast, Orange, N. J	6,728.00
Hutchinson & Alexander, Alleghany, Pa.	6,655.00
Ludlow Valve Mfg. Co., Troy, N. Y	6,602.50
Tamaqua Mfg. Co., Tamaqua, Pa	5,315.00
Eddy Valve Co., Waterford, N. Y.	5,370.00
Treman, Waterman & Co., Ithaca, N. Y.	5,058.00

Matthew's Patent.

George H. Titcomb, New York	$14,150.00
George B. Inman, New York	7,110.00
McRitchie & Nichol, Chicago, Ills	7,110.00
Florence Iron Works, Florence, N. J	7,110.00

On September 11th contracts were awarded as follows:

To Francis C. O'Reilly, of Orange, N. J., for pipe laying and rock excavation in the trenches.

To Freel & McNamee, of Brooklyn, N. Y., for building the dam and clearing the land therefor.

To "The Warren Foundry and Machine Co." of Phillipsburgh, N. J., for pipes and special castings.

To I. S. Cassin & Co., of Philadelphia, Pa., for gates; and

To "The Florence Iron Works," of Florence, N. J., for hydrants.

And all the contracts have been duly executed.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.
Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR............ASSOCIATE EDITOR.

SATURDAY, SEPTEMBER 23, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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THE IRON MANUFACTURERS AND THE STRIKE.

The ironworkers' strike has terminated in favor of the manufacturers after a fruitless effort continued through almost three mouths. The only element of uncertainty from the beginning was the determination of the mill-owners, or rather lack of determination. Heretofore, all strikes in rolling mills were successful, because the owners, one after the other, gave in, and their chief excuse or justification was that they had to protect their trade. This time a federation was formed of the iron and steel manufacturers of the United States, not only in view of the then present emergency, but for all future emergencies of like character, the condition or basis of which was that when any manufacturer or firm was obliged to resist a demand for an advance of wages, the federation, divided into districts, should pay each a certain sum per day or week for each idle furnace. This action provided the missing link. The plan was put into action early last June, and has been attended with signal success. It drew all manufacturers together, and assured each that no advantages would or could be taken of any. Another fact which enabled the manufacturers to resist the strikers so successfully was, that the demand for iron and steel has been gradually declining since the opening of the year, a result indicated by the declining activity in railroad building, which began with the opening of the present year. Railroad builders curtailed requirements, and railroad managers curtailed demands for equipments, rolling stock and motive power. This was early reflected in a limitation of orders for smaller material. Bar mills, plate and sheet mills and furnaces, booked fewer orders, and for smaller amounts. Manufacturers saw the indications of restricted demand and became apprehensive. Capacity for the production of every kind of iron had been expanded, and was being expanded. Prices began to sink in March; April and May sent them lower. A partial suspension was inevitable, unless some new influence was exerted. The ironworkers, who for two years had been adding to their numbers, and extending branches of their organization wherever they found it possible, resolved to use the power of which they felt themselves possessed, and presented demands to the mill-owners for $6 per ton for boiling iron instead of $5.50. The other branches of skilled labor presented their demands also, as part of the one request. The manufacturers refused as they were obliged to, and an hundred mills were idled on June 1st. They knew from experience that the strike would be a long one, but they knew what the workmen did not—that the market requirements would allow them room to resist. Had they not federated the result might have been different. Concessions on the part of a few weaker manufacturers would have encouraged the strikers, and increased the fears of the manufacturers themselves, who are ready to make sacrifices to protect their trade.

The one hundred and twenty suspension days which will be completed on this Saturday have been of immense advantage to the manufacturers. It has cleared all old stocks of iron out of the market. Consumers have used up everything, and have been ordering supplies for current wants with great caution. Hence business opens next Monday, in all markets from Boston to St. Louis with no iron on hand, and order books crowded with orders. Numerous requirements were withheld during the summer, and these will increase the volume of business to be disposed of during the last quarter of the year. The price of iron and steel for the next twelve months can be known with almost absolute certainty. The volume of business will regain normal limits, and the trade will derive substantial advantages by the strike. Restriction has been enforced in other industrial departments. The production of coal was restricted by the action of mine owners in Eastern Pennsylvania, resulting in an enhancement of values.

While these agencies were working out desired results and conditions, other agencies were at work to lay the foundations for greater industrial activity. The crops are large. Traffic has begun to swell to enormous proportions. Railroad earnings are increasing and dividends are encouraging. Inquiries for railway materials are coming in, and the evidences of a greater general demand, while not numerous, are much more gratifying than six months ago. The conditions are favorable for an increase of activity in the iron industry. The mileage for this year is over seven thousand miles, much in excess of same time last year, and new enterprises are being heralded to the public almost weekly. Several elements of uncertainty still exist, and investors have been taught lessons of prudence, which they will not forget, even in the present period when there is so much to encourage.

Apart from accidental causes, such as the recent strike, the tendency of years is downward. That tendency has been temporarily checked by the strike and by the firmness developed in the British iron market, and which continues up to the present hour. The probabilities are that prices will be firm for a few months, but in time the gradual accumulation of products will produce the downward tendency which results from a rapid increase in the iron-making capacity.

Railroad building has been prosecuted with regularity all summer, and is still going forward rapidly. Mills have orders enough to keep them busy half through the winter. Large orders of late have been exceptional. Quotations are $45 for large lots, winter delivery, which, it is stated in some quarters can be shaded when the buyers are ready. The Convention of Manufacturers at Cresson have anticipated the probable action of Congress in recommending to the Tariff Commission a reduction in duties from $28 to $22.40 per ton. Domestic rail makers will probably be able to take care of their interests in any event. The occasion of complaint against steel rail makers, on the score of enormous profits, disappeared since prices of rails declined from $80 per ton to $45. In a short time the productive capacity will be over two million tons per annum.

The abundant harvests will help to reduce cost of production, cost of living and rate of wages, and in this may increase the protection from foreign products already enjoyed. In fact, there are agencies at work which in time will place the American manufacturers in a better position to control the domestic markets without artificial assistance, which must always be a bone of contention as to amount and method of conferring it.

* * *

INCREASING THE WATER SUPPLY OF BROOKLYN, N. Y.

Brooklyn, for the past two or three years, has had but two alternatives to choose from to settle the water-supply problem—to increase the supply or decrease the daily rate of consumption. In the report of the chief engineer, Robert Van Buren, for the year 1881, we find a recommendation for the construction of a well similar to those built on the water-shed between East New York and Jamaica. It was proposed to construct galleries running east and west from this well. This water-shed contains about eight square miles, and if the supply obtained should warrant it, it was advised to extend these galleries so as to intercept all water flowing to the ocean from this shed. From this source 3,000,000 gallons could be positively obtained, and perhaps 5,000,000. If to do this cost $200,000, the annual interest on which would be $10,000, and the cost of maintenance and pumping was $6,000, the annual cost would be $16,000. The report states that to go east of Freeport, where the first stream of any importance is found, would cost $1,000,000, and the supply secured would be 5,000,000 gallons daily. The annual interest would be $50,000. This gives a saving in favor of the well system of over $30,000 per annum.

In accordance with these views, plans were advertised for, and the result was five bids received. The specifications stated that the party bidding must establish the feasibility of his plans, by reference to works built by him, or by conclusive proofs. All the propositions were to give a full description of the work, together with the necessary pumping capacity, engine-house, chimney, connections, foundations, land required, etc. A duplicate engine, as a reserve pumping capacity, was provided for at each station. The location, plan of wells, engines, etc., to be shown in detail on such scale and dimensions as to enable the chief engineer to judge of the entire system. The location must be near the line of the city conduit, and between certain points. Bids to state the price of the entire work, and time required to build. After completion the pumping will commence and continue uninterruptedly for one year. The permanent supply will be determined from the minimum yield during that time. The department will take charge of the works during that time, pay all expenses, and upon their successful operation will depend their final acceptance by the city. The contractor to supply all necessary mechanical apparatus for keeping a perfect record. Bidders were required to state the average daily supply they may be willing to guarantee, but this will not be accepted until after the year's test. If the supply should fall below the guaranteed amount, it will be optional with the Commissioner of City Works to reject the works, or accept them at such a reduction in price as the ratio of the total cost bears to the reduced supply obtained by them. Fifty per cent. of the contract price will be retained until the works are accepted by the Commissioner. Bonds required for the faithful performance of the work.

The following bids were received:

A. J. L. Loretz, 10,000,000 gallons for.	$450,000
D. H. Valentine, 3,000,000 gallons for..............	170,000
Freel & McNamee, 4,000,000 gallons for....	185,000
Thomas Newman, 3,000,000 gallons for...	125,000
Andrews & Co., 5,000,000 gallons for..............	180,000

The cost per million gallons would be:

A. J. L. Loretz....................................	$43,000.00
D. H. Valentine....................................	56,666.67
Freel & McNamee	46,250.00
Thomas Newman....................................	41,666.67
Andrews & Co....................................	36,000.00

To receive the requisite amount of water the plan proposed by Mr. Loretz contemplates three compound wells, each 50 ft. and 20 ft. in diameter, and 50 ft. and 80 ft deep. These three wells to be connected by galleries extending east and west at a depth of 20 ft. The pumping station to be at the middle well. The plan is an expensive one, although probably the best for a well and gallery system. The galleries would run 1,200 ft. each way from the wells.

Mr. Valentine also proposed to construct three wells, 50 ft. inside diameter, with galleries running from each well at right angles to the direction of flow. Wells to be placed in the valley of the watershed. To have a depth of water below the spring level of 16 ft.; the galleries to be 6 ft. wide and 16 ft. deep.

Messrs. Freel & McNamee also proposed three wells, 30 ft. in diameter, a depth of water of 17 ft., and located within 400 ft. of the conduit line. On each side of the wells, and at a distance of about 2,000 ft., they would place small wells 8 ft. in diameter, giving a water depth of 15 ft. An 8-in. pipe would connect these wells to the engine at the central well.

Mr. Newman proposed wells and stations similar to those now at Springfield and Watt's Pond.

Messrs. Andrews & Company—whose proposal was accepted—proposed a system of driven wells. The wells are patent air tight, filtrating, tube wells, operated under the Shaw gang-well patent. The gangs to be located near the conduit, and to have two or three pumping stations to secure the 5,000,000 gallons guaranteed.

The total cost of the work will be as follows:

Contract for the complete work	$180,000
Land damages estimated	8,000
Engineering, inspection, etc	5,000
Running the pumping stations one year, enginemen, firemen, coal, etc	12,000
Contingencies, 5 per cent	10,250
Total	$215,250

PERSONAL.

GENERAL ROSSER has been appointed chief engineer of the Hudson Bay Railway Company.

A dispatch from Cleveland, dated Sept. 18, says: The resignation of **SAMUEL BRIGGS** as superintendent of the Valley road has been accepted, and **J. E. TURK**, late chief engineer of the Valley road, has been given his place. **BRIGGS** goes to the Connotton narrow-gauge road, a rival line, as general manager, in place of **WILLIAM W. HUNGERFORD.**

ONTARIO (CAN.) NEWS.

The work on the aqueduct at Welland is progressing most favorably, and the coffer-dam inclosure will be unwatered by the middle of October at latest. This important link in the Welland Canal attracts great attention, for as soon as the aqueduct is finished the deepening of this great water-course is completed for vessels of fourteen feet draught. Great care has been taken by the contractors, Messrs. Beemer & Sullivan, and much credit is due to their engineer, Mr. J. Vincent Browne, for the manner in which the coffer-damming has progressed; having to contend against 23 ft. of water great caution was necessary. We hope to be able soon to give our readers a more detailed account of this important engineering work.

We gave a brief notice in a previous issue of the Murray Canal. This work will attract much attention for the next two or three years, and, as the work is in the hands of so efficient a manager as Mr. J. D. Silcox, we can insure a perfect success. The firm name is J. D. Silcox & Co. Mr. Silcox is a young man, and came into Canada but five years ago as manager for the firm of Vandusen & Co., of Syracuse, and, certainly, from the strides made, he is bound to rank among the first in the army of contractors. The amount of his present contract is $750,000.

The dry dock at Collingwood is progressing favorably and will, in all probability, be finished before winter sets in.

Section 34 of the Welland Canal was awarded to Charles Dunbar, of Buffalo. Most of the work to be done is rock. This section was taken over from McNamee & Co. by the government, as the contractors could not finish it. The people of Welland are now looking forward to the commencement of the water-course for mill privileges, for which the government has granted $26.0 0. Many hungry contractors will be on hand for the job.—*Communicated.*

THE FIELD BUILDING.

One by one, gradually but surely, the old edifices of this city that have stood as landmarks for the past fifty or one hundred years are being removed and in their stead are reared buildings more in keeping with the advance and demand of the present time. The most recent case of this description is the removal of the Washington House at the foot of Broadway and on the corner of Battery place, to make room for what might most aptly be termed a business palace. When Battery Park was the evening promenade of the "best" society of New York, and when the residences in the immediate vicinity were occupied by the foremost men of the city, the Washington House loomed up and was at the height of its glory. As the resident portion of the town moved up, being displaced by the demands of business, this house was occupied as offices.

The building which is now being erected on this site by the Washington Building Company, composed of Cyrus W. Field, his son, son-in-law and other well-known capitalists, will be bounded by Broadway, Battery place and Greenwich st., having a facing on Battery place of 175 ft. and a depth of 100 ft. The style of architecture, situation—commanding an unrivaled view of the entire harbor—and the massiveness of its proportions will combine to render it one of the most imposing structures in the lower part of the city; while its interior arrangements, having but one end in view—the convenience and pleasure of its prospective occupants—will contain all the appliances in modern building conducive to comfort and health. The architect has paid particular attention to the sanitary problems connected with the building, and we have no hesitancy in predicting a total absence of all noxious gases commonly designated "sewer gas," which are constant visitors in some of our prominent office buildings and which not only offend the olfactories, but are prejudicial to health.

The building will be eleven stories high and will be 155 ft. from the sidewalk to the top of the main roof, which will be surmounted by a cupola on the center of the Battery place front. This cupola will be 240 ft. high and will be furnished with a promenade from which the surrounding country can be viewed. The famous "four windows" of Trinity Church will be henceforth ranked as second in point of height to which visitors can ascend.

The fronts will be of Philadelphia brick with trimmings of carved Belleville stone, the two forming a contrast most pleasing to the eye. On the corner oriel windows will be carried all the way up.

The foundations have been carried down to bedrock in order to insure perfect stability and prevent all possibility of settling. In some places this required an excavation of from 40 to 45 ft. The cost of the foundation wall to a height equal to the sidewalk has been about $100,000.

The main entrance to the building will be at the center of the Battery place side; there will also be one on Broadway and one on Greenwich street with a corridor extending through and connecting the two. The main office on this floor will occupy the entire front, its dimensions being 41 by 160 ft. In the oriel at the corner will be a private door for this apartment. The other rooms will be 40 by 40 ft. and 47 by 36 ft.

The second and third floors will be divided into 30 offices each; the upper stories will be divided into 34 rooms each. This will give a total of 230 offices on the floors above the first. The subdividing of these rooms is not arbitrary but will be arranged to suit the wants of the occupants.

Every precaution has been taken to make the building fireproof. All the iron work will be covered with a fireproof casing; the iron columns will be covered with a layer of Keene's cement, about 1½ in. thick. As a protection against fire from the outside all the jambs and casings of the windows will be covered with a layer of Keene's cement, thus leaving only the frames and sashes of wood. The staircases will be of stone and iron.

There will be five elevators in the building, located in different parts so as to afford quick means of reaching any particular section.

An open fireplace will be built in each office. Heat will be obtained from boilers in the cellar. Wires for electric light and other purposes will be put in at the time of building. The interior will be finished throughout in hard woods.

The *Mail and Express* will have its editorial and composing rooms in the upper floor and its presses in the basement.

One most novel feature in the building is the ornamentation found in the plans for the open court. This is a most agreeable departure from the conventional rules which condemn rear tenements to feast their gaze upon rough walls covered with an annual coat of whitewash.

According to the estimates, the building will cost about $1,000,000.

The architect of the building is Mr. Ed. H. Kendall, of 71 and 73 Broadway. Some of the most imposing buildings in this city have been erected after the plans of Mr. Kendall—the Equitable on Broadway; the German Savings Bank, corner of Fourteenth st. and Fourth ave., and (now in process of construction) the mansion of Messrs. Robt. and Ogden Goelet, on Fifth ave. The design for the exterior of the present building might be not inappropriately termed "free classic." The details will be of the colonial school in which the old Washington House was built.

THE CONTRACTS.

The contracts have all been let with the exception of the two upper stories, and the carpenter work, plumbing and steam-fitting and apparatus.

W. H. Hazard & Sons have the contract for the foundations. The remainder of the mason work is by Bernard Spalding. J. B. & J. M. Cornell have the contract for the iron work. Brown & Co. are doing the cut-stone work. The New York Stone and Fireproofing Company are doing all the fireproofing. T. B. Galligan & Co. have the contract for the sheet-piling required and the blasting.

At the time of the letting of the contracts the rates of wages and prices of materials were so high that it was deemed advisable to postpone the lettings for the two upper stories to some future time, when it is expected much more advantageous terms can be obtained.

RECENT INVENTIONS PATENTED DURING THE PRESENT WEEK.

BRIDGE.

In this novel improvement blocks of rigid material are threaded upon cables, the latter being put in such tension within the blocks and against the ends of the series as to make a substantially rigid beam. Truss members are also combined therewith.

RAILWAY DITCHING MACHINE.

A late invention describes a device consisting of a railway truck, which bears derricks with tackle adjustably supporting angular carriers with like plows and belts running on two series of rollers communicating by an oblique rod and bevel gears, and inclined to each other, and having a central joint belt and low, spring-fastened inside boards. The carriers have supporting rods, adjustable by rack-bar and pinion, screw rods and hinged joints. Transverse carriers conduct the material to an endless conveyer formed of beveled overlapping slats joined by central and end links, and having hangers with rollers which run on trackways in suitable cars. The conveyor is driven by rag wheels in the end car engaging with the hangers. Independent engines operate the several belts.

ELEVATED CABLE-RAILWAY.

In an elevated cable railway the car is suspended near the street surface by rods connected with the track above. This track has flangeless wheels, which are kept upon a smooth surface rail by guard-wheels running horizontally in immediate proximity to the wheels and against the inner face of the wheel.

UTILIZING EXHAUST STEAM.

This improved process consists essentially of a forced hot-water jet united with dry or superheated steam, said steam and water being taken from one common source, and with the said exhaust forced into the water-body of the same boiler from which they were taken.

INCANDESCENT ELECTRIC LAMP.

A late English invention consists in the manufacture of the glass enclosures for incandescent lamps, comprising the preparation of the vessel to receive the wire by, when the glass is hot, deflecting inward a portion, then detaching the said portion, and, after fixing the wires, again completing the vessel by sealing the detached portion.

STEAM-TRAP.

This novel steam-trap is provided with a movable tank attached to the float, arranged and constructed so as to alternately receive and discharge water, and by its consequent change of weight render the movements of the float more positive.

SUPPORT FOR ELECTRIC LIGHTS AND CONDUCTORS.

The spindle of a stationary lamp-post is used in connection with a tubular extension fitted to and extending above the same. Means are provided for adjusting the upward direction of the tubular extension. F. B. BROCK.

WASHINGTON, D. C.

NEW YORK, ONTARIO & WESTERN AND NEW YORK, WEST SHORE & BUFFALO RAILWAYS' WORKING FORCE.

WEEHAWKEN TO MIDDLETOWN.—CORNWALL TO SYRACUSE.

19,337 men...	19,337
110 steam and compressed air drills, equal to	1,320
19 steam excavators	1,900
4 dredging machines	1,600
	24,157

3,690 horses and carts; 28 locomotives; 1,252 cars; 20 pile drivers; 69 steam derricks; 9 steam pumps; 27 tugs, scows and canal boats.

(Signed.) WALTER KATTÉ, Chief Engineer.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

A meeting of the Society was held at its house, in 23d street, New York, at 8 P. M., Wednesday, Sept. 20, 1882, Vice-President Wm. H. Paine in the chair. A paper describing the methods used in a rapid topographical survey of a portion of the gold field of Nova Scotia, by Wm. Bell Dawson, was read, in the absence of the author, by the Secretary. This survey was made by the use of stadia hairs and a Rochon micrometer telescope for the measurement of distances, and resulted successfully and with very moderate expense. Col. Wm. H. Paine, Vice-President of the society, described the methods in use by him in making surveys for the campaign maps of the Army of the Potomac during the war, observations often being taken from the tops of trees, and the resulting maps showing remarkable accuracy. Mr. Robert B. Stanton, M. Am. Soc. C. E. of the U. P. R. R., described rapid surveys made by Mr. Blickensderfer and himself in preliminary reconnoissances for the Pacific Railways.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 328.)

CCCLXXXI.—LEE, MASS.

Lee, Massachusetts, in lat. 42° 30' N., long. 73° W., is in a very broken and rolling country on the Housatonic River.

Settled in 1760, it was incorporated as a town in 1776.

Water-works were built by a private company in 1881, taking the supply from a stream, which has 6 square miles water-shed, on which an impounding reservoir, holding 20,000,000 gallons, is formed. The water is conducted by cement-lined wrought-iron pipe to a distributing reservoir, holding 1,500,000 gallons, at 212 ft. above the village.

Distribution is by 4½ miles of cement-lined wrought-iron pipe of 10 in. to 1 in. diameter, with 4 fire hydrants, 17 gates and 80 taps.

Wrought-iron and cement-lined service pipes are used.

The population in 1880 was 5,000. The daily consumption is not determined yet.

The capital stock of the company is $30,000.

M. H. Pease is Treasurer.

CCCLXXXII.—NORTH ADAMS.

North Adams, Massachusetts, in lat. 42° 42' N., long. 73° 8' W., is in a hilly country and on the Hoosac River.

Water-works were built by the town in 1865, taking the supply from a mountain brook. The water is collected in a reservoir holding 100,000 gallons, from which it passes to a subsiding reservoir containing 10,000,000 gallons, and is then conveyed to a distributing reservoir holding 750,000 gallons at 250 ft. above the town.

Distribution is by 18 miles of cast-iron pipe with 110 fire hydrants. The number of taps is not given, nor the consumption. The supply is hardly equal to the demand, and in 1879 it was necessary to limit the consumption during the dryest season. The population in 1880 was 10,192.

The works have cost $180,000. No further financial statements are given.

The works are controlled by the Prudential Committee of the fire district. Thomas A. Hodge is the Superintendent.

TO BE CONTINUED.

The receipt of statistics as follows is acknowledged with thanks: From M. H. Pease, Treasurer, statistics and water rates of the water-works of Lee, Mass. From S. W. Brayton, statistics of the water-works of North Adams, Mass. From J. H. Peabody, statistics of the water-works of Cañon City, Col.

A VALUABLE BOOK OF REFERENCE.

A gentleman had a longing to "ride a bobby," and so he started a paper, which is a "bobby" that is usually considered expensive to ride. This gentleman was, and is, an enthusiast, as all men who accomplish much are, and his interest in, and love for, his pet journal grows with its growth. The outcome of money lavishly spent in subsidizing the ablest writers on sanitary matters, in collecting opinions that cannot be refuted, and in every way endeavoring to build up an authoritative journal on sanitary subjects, is *The Sanitary Engineer*, now in its sixth volume, which commenced June 1st. In quality of paper, beauty of typography, and value of its matter, this journal is a decided success. Personally, we do not admire its make-up, as it obliges the advertisements to be bound up with the reading pages. But that concerns only the proprietor and his patrons. We have the *fifth volume* before us. It comprises the 26 numbers from Dec. 1st last to May 25th, and forms a book of 532 pages, in substantial and neat binding. It contains

Reviews, comments, and criticisms by experts on events of special interest to sanitarians, health officers, analysts, architects, civil and sanitary engineers, gas engineers, electricians, plumbers, gas fitters, hot-water engineers, steam fitters, builders, pharmacists, and manufacturers of food products.

The answers, with illustrations, to a great variety of practical questions relating to plumbing, drainage, sewerage, steam fitting, hot-water circulation, the fitting up of hot-water boilers, and water supply, make it invaluable to the mechanic and professional man.

A complete record of all United States patents for fixtures and appliances used in plumbing, sewerage, gas fitting, gas manufacture, steam and hot-water heating, ventilation, and electric lighting, makes it valuable to Inventors and Manufacturers.

The following are a few of the many articles of permanent interest:

A review of Town Sewering in England, with opinions on the question of Small versus Large Sewers, or the Combined versus the Separate Systems, by Robert Rawlinson, C.B., Chief Engineer, Inspector Local Government Board, England.

A Report on the Sewerage of Concord, by Edw. S. Philbrick, C.E. Instructive to town authorities generally.

Remarks by John S. Billings, Surgeon U. S. Army, before the Academy of Medicine, New York, on Sewer Gas and the value of Modern Methods for excluding it from Houses. This article throws considerable light on a question generally misunderstood.

Electric Lighting: Its Fire Risks and their Remedies. Two articles by Prof. Henry Morton, President Stevens' Institute of Technology, Hoboken, New Jersey.

Illustrations, with description of the Arrangements for Heating and Ventilating the Bridgeport School-House (intended to be a model building).

A continuation of Dr J. S. Billings' Letters to a Young Architect on Ventilation and Heating, with illustrations of notable buildings.

A continuation of the "Sanitas" articles on Plumbing Practice (illustrated). Interesting to architects, builders and plumbers.

A criticism of Plans to Ventilate House Drains by Gas Jets, in connection with attempts made by a Mr. Mineard in London (illustrated).

Steam Fitting and Steam Heating, by "Thermus," a series of practical articles (illustrated), of great value to steam fitters and architects.

Illustrated Descriptions of notable jobs of Plumbing, Heating, and Ventilating in Private Residences in the United States, including those of Mr. W. H. Vanderbilt and Mr. R. H. Bishop, of New York.

A series of articles on Petroleum Legislation in the United States, by E. G. Love, Ph.D.

A Report to the Greenock Board of Police on the Ventilation of the Sewers of Thirty-three Towns in England, compiled from information received from City Engineers, by Alex. J. Turnbull, C.E. Valuable to engineers and health officers.

Filtration of Sewerage, by Prof. Henry Robinson, M. Inst. C.E., being a report on certain processes.

Hints to Housekeepers, by E. S. Philbrick, C.E. (on the Sanitary Care of Dwellings).

A series of carefully prepared editorials on the Water Supply of New York, discussing the various schemes proposed for increasing it; also the measures to prevent waste. Opinions of prominent English Engineers on the practice in England, and suggestions for American adoption, in connection with a controversy over the rules of the New York authorities with regard to the manner of Flushing Water-Closets. The letters and articles on the question of Valve versus Direct Supply to Water-Closets are of great interest to manufacturers, plumbers, health officials, and water-works engineers.

Description, with illustration, of Methods for Heating Railroad Cars by Steam from the Locomotive, as practiced by certain railways in the United States.

Ventilation of the Packer Institute, Brooklyn. Interesting for school authorities, as showing the methods adopted to ascertain its condition.

Plan, with description, of the proper way to arrange the Drainage of a Villa at Saratoga. Of interest to persons building country residences.

Reports on Adulteration of Food and Drugs in the State of New York, being full abstracts of the reports of Professor Chas. F. Chandler, on Milk (Fresh and Condensed); Professor G. C. Cornwell, on Butter (Dairy and Artificial), Cheese, Lard, Olive Oil and Fruit Essences; Professor A. H. Chester, on Canned Meats and Animal Foods; by Dr. E. G. Love, Ph.D., Cereals and the Products and Accessories of Flour, Special Artificial Food for Infants and Invalids, Baking Powders, Cream Tartars, Alum Powders and the "Alum Question;" by Professor A. S. Lattimore, on Canned Fruits and Vegetables, Vinegar Spices, etc.; W. H. Pitt, M.D., on Sugars, Glucose, etc.; J. E. Englehardt, Ph.D., on Wines, Beers, Spirits and Cordials; by J. Hoffman, Ph.D., on Crude Vegetable and Animal Drugs, Pharmaceutical Chemicals and their Preparations; by Professor Caldwell, on Quinine in Pills and Capsules; by W. G. Tucker, M.D., on Citrate of Magnesia and Seidlitz Powders.

These reports are on examinations made under the direction of the New York State Board of Health with a view of ascertaining the condition of the food and drug supply in the State, and the extent and character of the adulterations practiced. They are valuable to health officials, analysts and manufacturers.

Notes upon some Prosecutions in Great Britain under the Food and Drugs Act, by Alfred Senier, M.D., F.C.S.

Paris Street-Cleaning, by James Tallmadge Van Rensselaer. An elaborate and full account of the system and the cost of its maintenance—of value to city authorities.

Illustration and description of the remodeled Drainage of the Executive Mannon at Washington, D. C.

An account of Fire-Proof Substances for Fabrics and Woodwork.

An article on the advantages of Double Glazed Window Sashes, by General M. C. Meigs, late Quarter Master General U. S. Army.

Illustration, with explanation, of the Causes of Explosions of Water Backs—for information of householders.

Washington Drainage, a carefully prepared review of the evils complained of, and the various schemes proposed for the reclamation of the Potomac Flats and the sewerage of the city.

The price of the bound volume is $3, with 40 cents postage added; for sale either at the office of *The Sanitary Engineer*, 140 William St., or at this office. The number of volumes is already limited to a very small edition.

CORRESPONDENCE.

CITY IMPROVEMENTS AND MALARIA.

MILWAUKEE, Wis., Sept. 15, 1882.

EDITOR ENGINEERING NEWS:

In your paper of the 9th inst. you copy from the *N. Y. Times* an article on "City Improvements and Malaria," in which occurs the following: "It has long been suspected by the most acute observers that there is an intimate relation between the development of malarial diseases and the setting free of the carbonic acid in the soil; in other words, that intermittent fever and kindred complaints are only another name for slow carbonic oxide poisoning, and that the hypothesis of malarial germs is a purely fanciful mode of accounting for the phenomena associated with these diseases."

In large cement works, the kilns are built in batteries, are continuous, and coal is the ordinary fuel. The carbonic acid of the stone burned is supposed to be set free in large volumes. Yet men work on the tops of the kilns, feeding stone and coal alternately, and necessarily inhaling all the products of the combustion, daily throughout the season, without any apparent injury to health. Accepting the theory of the *Times* as correct, what is the explanation? INQUIRER.

MALARIA IN CONNECTICUT.—Malaria is getting to be Connecticut's worst bugbear, and the shakes in some sections never let up. The State Board of Health, who are trying to get at the source of the trouble, are subjecting the drinking water of these sections to a careful analysis.

SAFETY IN RAILWAY TRAVEL.

We now come to a class of accidents which are perhaps more fatal than any others—the breaking down of bridges. In these catastrophes all horrors combine—crushing, mangling, drowning and burning; and here again our record is not at all encouraging, the number of bridge disasters in the United States having been as follows:

1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
19	33	26	20	21	21	17	16	43

If we left out the first and the last of the above numbers we might flatter ourselves that a gradual improvement was taking place; but what are we to say of the 43 disasters in 1881, which seems to be the worst year we have ever had, and this in spite of the fact that we have been all the time improving our knowledge and our practice of bridge building, and that we certainly know more about such work now than we ever did before.

Railroad bridges, whether of wood or iron, can be so made as to be entirely safe under all ordinary conditions of service, and they can be kept under such inspection that no element of danger shall be allowed to develop itself. While, however, our larger roads as a general thing buy good bridges and keep them under a rigid inspection, many of the smaller roads buy poor bridges and keep them under no inspection at all, for the examination of an iron bridge by the ordinary road-master, or the walking over these structures by railroad commissioners once a year, can hardly be regarded as inspecting. The Ashtabula bridge, which broke down in 1876 on the Lake Shore Railroad, killing over eighty persons, fell, it is stated by the legislative committee appointed to investigate that disaster, "under an ordinary load, by reason of defects in its original construction, which defects would have been discovered at any time after its erection by careful examination," and the report adds: The bridge was liable to go down at any time during the past ten or eleven years, under the loads that might at any time be brought upon it, in the ordinary course of the company's business, and it is most remarkable that it did not sooner occur. Half an hour of competent and honest inspection would have condemned the Ashtabula bridge upon the day it was finished.

The Tariffville bridge—which fell in Connecticut in 1878, killing thirteen persons and wounding thirty-three more—is not an unfair specimen of a large class of wooden bridges in use to-day upon American railroads. In point of design, proportions, dimensions and reputation of its builders, it was fully up to the average of such structures. It had been periodically inspected and pronounced all right. While no competent expert would ever have pronounced it a first-class bridge, no person could say from looking at it that it was not able to carry the ordinary railroad train safely, but when the right combination of circumstances came, it fell, and exposed the hidden defects that caused the disaster. Though nominally a wooden bridge, like all such structures it relied entirely upon wire rods to keep the wood-work together. These rods, it is reported, when tested broke with a single blow of the hammer, very much in the manner of cast iron, and showed a very inferior quality of material. This was a defect which no ordinary inspection would detect, and one which may exist to-day in hundreds of bridges now in use upon our roads. We have in this country no system of control or inspection which can prevent the building and the use of exactly such bridges as that at Tariffville. It may be asked if any railroad company being, of course, aware of its liability for damages—will knowingly allow a defective structure to be made or used upon its road. It is perhaps hardly fair to say that such things are done knowingly, but they are certainly done heedlessly, and the result is the same. Not less than half of the wooden bridges made upon our railroads, and upon many of our best roads, too, are built by mere carpenters who can do just one thing, perpetuate the blunders they have been brought up to. Not one half our wooden bridges have ever been subjected to any computations whatever, but have been proportioned by a kind of guess-work, based upon a greater or less degree of experience it is true, but an experience of a very unsystematic kind. Add to this that nearly all of our older bridges were designed for trains and engines much lighter than those in present use, that there are many disreputable concerns which build very poor and unsafe iron bridges, and railway directors willing to buy such things because they are cheap, and finally that we have no efficient system of inspection, and we need not wonder that 24 bridges on an average break down every year. At the same time, we must bear in mind that there is no need for this class of catastrophes, that any company can at any time buy a bridge of a first-class concern, which shall be guaranteed absolutely safe and permanent by the very best authority.

We can have as much safety as we choose to pay for. As a general thing, the managers of our larger roads are well aware that they cannot afford to run any very great risks; they are intelligent, they are progressive, they are liberal; and we need no better evidence of the skill and care with which railway traffic on the whole is carried on than the fact that not one passenger in a million is killed in this country by any cause for which the company can be held to blame.

Except in one or two States we have no system of public inspection which has ever been able to detect the weak points in a railroad or prevent disasters; and, considering the form of our government, it is quite doubtful if we ever shall have. The way, however, to all desired improvement is very plain, if the public and the companies care enough about safety to exert themselves to get it. We have already seen that the public is itself accountable for by far the larger part of the injuries, and to that extent it must mainly rely upon itself for increased safety. A careful examination of the various causes of railroad accidents shows that three-fourths of all injuries to individuals may be avoided by obeying the following very simple rules: First—Never walk upon a railroad track or bridge. Second—Never cross a railroad without first looking in both directions for a train. Third—Never get on or off the cars, nor pass from one car to another, nor stand upon the platform when the train is in motion, no matter how slow that motion may be. Be especially careful in regard to the above rules when in or about railroad stations, and remember that the disaster, when it occurs, always comes in an unexpected form at an unexpected time.

Of the remaining one-fourth part of all accidents, the control of which is in the hands of the railroad companies, by far the larger part can certainly be avoided by means of the improved methods of construction, maintenance and operation which have been thoroughly tried and demonstrated to be good. Well paid and competent employés whose personal interest is thoroughly enlisted for the welfare of the road, a rigid system of personal accountability—through every grade of service intelligent use of the telegraph, in train movement, well designed, thoroughly built and carefully inspected roadway bridges and rolling stock—these are the guarantees for exemption from railroad disasters.—*Geo. L. Vose in North American Review.*

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COST OF A BOMBARDMENT.

The papers publish some interesting information as to the cost of each shot of the guns employed in the recent bombardment of the Alexandrian forts. The following is the bill for the discharge of a single round:

Four 81-ton guns	at	£25 10 0	£102 0 0
Ten 25-ton guns	at	7 0 0	70 0 0
Thirty-eight 18-ton guns	at	5 5 0	199 10 0
Sixteen 12-ton guns	at	3 12 0	57 12 0
Eight 9 ton guns	at	2 15 0	22 0 0
Two 6½ ton guns	at	1 15 0	3 10 0
Four 64 pounders	at	0 18 0	3 12 0
Seven 40-pounders	at	0 12 0	4 4 0
Eighty-seven guns			£462 8 0

When a single round costs nearly £500, what must a day's bombardment have cost?—*Pall Mall Gazette.*

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THE GROWTH OF THE UNITED STATES.

Francis A. Walker, the superintendent of the last census, contributes to the October *Century* a paper abounding in interesting and important facts gleaned from the census return since the first enumeration in 1790. In discussing the condition of the United States, at the tenth census in 1880, he says:

The period between 1850 and 1880 has been marked by the astonishingly rapid spread of population over the vast region brought under the flag of the United States by the purchase of Louisiana, the annexation of Texas, and the cessions from Mexico. The 980,000 square miles of territory occupied by settlements in 1850 have become 1,570,000. Of these, 384,820 have between 2 and 6 inhabitants to the square mile; 378,890 have between 6 and 18; 554,300 between 18 and 45; 232,010 between 45 and 90; while 24,550 have in excess 90 inhabitants to the square mile. The population of the United States is now 50,155,783. The frontier line of settlement is, in general, the one hundredth degree of longitude as far north as the forty-second parallel of latitude, and, thence northward, the ninety-ninth and afterward the ninety-eighth degree.

The distribution of the population according to dominant topographical features may be thus stated: On the immediate Atlantic coast, north, 2,616,892; middle, 4,875,184; south, 875,287; on the Gulf coast, 1,055,851; in the hilly and mountainous region of the northeast, 1,669,226; in the mountainous region of the central Atlantic slope, 2,344,223; in the immediate region of the Lakes, 3,049,470; on the table-lands and elevated plateaus of the interior, 5,716.826; in the south central mountainous region, 2,695,085; in the Ohio Valley, 2,442,792; on the south interior table-lands and plateaus, 3,627,478; in the Mississippi belt, south, 710,268; north, 1,991,362; in the southwest central region, 2,932,807; in the central region, 4,401,246; in the prairie region, 5,722,485; in the Missouri River belt, 835,455; on the western plains, 328,819; in the heavily timber region of the northwest, 1,122,337; in the Cordilleran region, 982,311; on the Pacific coast, 715,789.

Although the territory of the United States extends to the forty-ninth parallel, only one-tenth of the population is found north of the forty-third. But so dense is the settlement below this line that, by the time the forty-first parallel is reached, about one-third of the population has been covered; the next single degree extends the proportion nearly to one-half, while more than two-thirds lie north of the thirty-eighth parallel. Between the forty-third and the thirty-eighth dwell 29,500,000 of our people. In 1870, 52.8 per cent. of the population was east of the eighty-fourth meridian. In 1880, only 49.4 per cent. was so placed. Eighty-four per cent. of the population is found east of the ninety-first meridian; 97 per cent. east of the ninety-seventh.

The foreign elements of our population have varied widely since 1850. At that time foreigners constituted 9.5 per cent. of the total population; they now constitute 13.3 per cent. Of the foreign residents of 1850, 43.5 per cent. were Irish; 26.4, Germans; 13.9, English and Welsh; 6.7, British-Americans; while the Scandinavians formed less than one per cent. Since that time, the proportion of Irish to the other foreign elements has steadily declined. Of the arrivals in the ten years ending in 1850, the Germans were but 25 per cent.; of those in the ten years ending in 1860, they were 37 per cent. Between 1860 and 1870, other foreign elements began to assume importance through the fast-increasing immigration of Swedes and Norwegians across the ocean, and of Canadians across our northern border. We have seen that the Irish of 1850 constituted 43.5 per cent. of the total foreign population. In 1860, this proportion had fallen to 38.9, and in 1870, still further, to 33.3. Although the statistics of nationality at the census of 1880 are not yet published, it is not probable that the Irish to-day constitute more than 27 per cent. of the foreign population of the country.

To-day, the number of foreigners living among us is a little over 6,500,000, while the members of the colored race reach almost the same number. Speaking roundly, then, the following is the table of our population:

Whole number	50,000,000
Foreigners	6,500,000
Total native-born	43,500,000
Colored	6,500,000
Total native-born whites	37,000,000

The location of the colored and the foreign elements of our population, as shown by the census, is, in a high degree, complemental. In general, where the one element is largely found, the other is absent.

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The *North American Review* for October opens with an article on "The Coming Revolution in England," by H. M. Hyndman, the English radical leader, giving an instructive account of the agitation now going on among the English working classes for a reconstruction of the whole politico-social fabric of that country. O. B. Frothingham writes of "The Objectionable in Literature," and endeavors to point out the distinction between literature which is *per se* corrupting, and that which is simply coarse. Dr. Henry Schliemann tells the interesting story of one year's "Discoveries at Troy." Senator John I. Mitchell, of Pennsylvania, treats of the rise and progress of the rule of "Political Bosses." Prof. George L. Vose, of the Massachusetts Institute of Technology, contributes an article of exceptional value on "Safety in Railway Travel," and Prof. Charles S. Sargent, of the Harvard College Arboretum, contributes an instructive essay on "The Protection of Forests." The *Review* is sold by booksellers and newsdealers generally.

NOTES.

PATENTS GRANTED DURING THE WEEK.

WASHINGTON, Aug. 22.—During the week ending to-day there have been granted at the Patent Office 389 patents, 68 designs, 11 trade-marks, 10 labels and 4 reissues of patents. The states receiving the largest number were New York, 106, 21 of which were granted to T. A. Edison; Massachusetts, 52; Pennsylvania, 37; Ohio, 34; Illinois, 32; New Jersey, 31; Michigan, 14; Connecticut, 13. Twenty patents and designs were granted to citizens of foreign countries, of which number England and Canada received 7 each.

AN IMPORTANT INVENTION.

J. B. Atwater, of Chicago, an inventor of some prominence, has received patents on an unique motor. It is founded on this principle: The poles of an electro-magnet are changed to a point distant from where they are usually located. By this transfer a stroke of from 5 to 30 in. is secured in a reciprocating or an oscillating engine, without breaking the current which connects the battery with the motor. With the greatly increased power thus gained there is no increased battery necessary. The power gained is said to be continuous and the cost is at a minimum. The machine will shortly be placed on exhibition. Scientific men agree that many of its principles are new to science, and that it may work a revolution in motors.

The Two Countries—

There is a land of tears and bitter wailing—
A land most like that drear one Dante knew,
Where wan-faced Niobes, with dark robes trailing,
In sad procession move, brow bound with rue.
It is a land peopled by witless mortals—
Compared with them the Virgins five were wise—
And it is writ above its gloomy portals:
"We did not think it paid to advertise."

There is a land that flows with milk and honey—
Not the condensed nor yet the sorghum strains—
Each dweller bears a gripsack fat with money,
Bonds, coupons, stocks and various other gains.
Happy are these as, at high tide, the clamlet;
No tear doth drown the laughter in their eyes;
For better luck they'd not donate one damlet;
The pastry's theirs—they learned to advertise.
Hatboro Public Spirit.

RAILROAD BUILDINGIN THE NORTHWEST.

[Puget Sound Courier.]

A correspondent who recently visited the "front" describes some of the difficulties of railroading in the Northwest. This is about the way it is done: The line having been laid, surveyed and staked, parties of white men, hundreds in a gang, proceed to mow down the forest. The trees are felled with surprising rapidity—it might be said that they are mowed down—and a broad swath, 200 feet wide, is opened up through the forest. The trees are immediately trimmed and cut into lengths and rolled out of the way, when other gangs of men attack these logs and split them into ties. Now comes another party of white men, who proceed to dig about the roots of the fallen trees; a keg (sometimes two) of powder is placed under the tree stump, a fuse attached, earth thrown about it and tramped down, a light attached to the fuse, and the stump is blown up. The white men pass on, and now come the Chinamen, thousands of them. They proceed under the direction of white bosses or "herders," as they are called, to level the earth, throw up a road-bed, carry ties from a construction train, or from teams close by, and lay them in place. Other gangs of Chinamen carry steel rails, and white men proceed to lay them and spike them. The supply train slowly moves forward as the track is laid, and other gangs of Chinamen follow on a gravel train and finish the new laid track. Thus the new railroad is being built towards the Mississippi River at St Paul.

GENERAL INTELLIGENCE.

☞ We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.

GAS AND WATER.

Increasing Greenfield's, Mass., Water Supply.—The committee who have been investigating the question of an increased supply of water for the town have reported. Raising the Glen reservoir 6 ft., at an expense of $4,000, which would increase the capacity of the reservoir several million gallons; also, building a reservoir on Rocky mountain, east of the village, which is 168 ft. above the arch on Main st., and running a pipe from the present Glen water main to the reservoir, which could be filled during the night. The water from this reservoir should be used for fires, for the railroads and for mechanical purposes, and it could be shut off in case of fire, so as to make the whole supply available. This would involve a total expense of $31,000. It is thought that this plan would give the town an ample supply for many years. The committee investigated various schemes, among others the West Glen brook and the pond at "Carpenter's mill." There was not sufficient water to warrant any movement in that direction. It is thought that it would not be advisable to lay larger pipes to the present water-works, which would involve an outlay of $80,000. It would cost $75,000 to try the Fish brook plan, though it is likely that this may be adopted, should the town need a much larger supply in future years. This brook has two branches, one rising in the town of Shelburne and the other in Coleraine, and so located that a head of 430 ft. could be obtained.

A Water-Works Paying Damages.—The town of Westboro', Mass., has been required to pay $5,894.25 to parties who had rights in a stream which the town diverted to fill a reservoir.

Water for Swampscott, Mass.—The Flax Pond Water Company, through its President, Charles Lincoln, of Boston, offers to give Swampscott a supply of water from Cedar, Sluice and Flax Ponds. No definite action will be taken on the water question until the Lynn Water Board and the Swampscott Water Company are further heard from.

The Columbus Water-Works, Ga., are nearly completed.

Ground was broken and work begun on the Spencer, Mass., water-works Monday, 11th inst., by the contractors, Messrs. Goodhue & Birnie.

The Fifth avenue reservoir, in New York, is not to be removed.

ELECTRICITY.

Edison tells a reporter that he does not believe a submarine telephone comes within the region of possibilities. He says: "The present condition of the art will not permit sound to be audible by submarine or underground conveyance more than a few miles. It is all they can do to talk across the English Channel, and that with the very best instrument yet constructed."

Kissing the Bible by Telephone.—John Freeman, assistant book-keeper in the Department of Public Works and notary public, before whom the various foremen are required to swear that the pay-rolls submitted by them are correct, took the affidavit of Wm. Inness, foreman of repairs at the crib, by telephone. Having called the crib, the following colloquy ensued:

"Is this William Inness?"

"Yes."

"I hold in my hand the pay-roll submitted by you for the month of August. Are you willing to swear that it is correct?"

"I am."

"Take off your hat and hold up your right hand."

"I have done so."

"You solemnly swear that the August pay-roll for repairs at the crib is correct?"

"I do."

Mr. Freeman readily distinguished Mr. Inness' voice and says an oath taken by telephone is binding in law. *Chicago News.*

The Edison Lamp Factory has recently been removed from Menlo Park, the inventor's home, to East Newark, N. J., to secure larger buildings, increased facilities, and more convenient accommodation for workmen. The tools and power now in the factory are sufficient for the manufacture of 1,200 lamps per day, but the ultimate capacity is stated to be 40,000 lamps per day, requiring from 3,000 to 4,000 workmen.

The validity of the Bell telephone patent in Canada has been tested in its favor.

STREETS, DRAINAGE, ETC.

Sewer Work Delayed.—New Haven has sewer work to the amount of $70,000 delayed for the want of money.

Sanitary Instructions to British Army.—The sanitary instructions sent in pamphlet form to the British army in Egypt say that camps should not be made on ground that has recently been flooded, nor should the surface be dug up more than is absolutely necessary for drainage. If turbid water must be used it should be allowed to clear itself as much as possible by subsidence, and a teaspoonful of powdered alum added to every ten gallons. The filtering of the water where possible is urged, and any water can be drunk if first boiled and then allowed to cool. Stringent directions are given that in cases of cholera or enteric fever all water is to be boiled before use, and distillation adopted if practicable. In the matter of food, it is advised that all meat be thoroughly cooked; that the consumption of vegetables and fruit be encouraged. As to beverages, strong alcoholic drinks are condemned, red wine is permitted, and tea, coffee, and cocoa are recommended. It is declared that tea is especially valuable where water is at all doubtful in quality, cold tea, with a little sugar and lime juice, being an antiscorbutic and making a refreshing drink.

Proposals Wanted.—Orange, N. J., advertises for bids for 5,100 lineal ft. of curbing; 1,570 square yards of cobble stone gutters; 10,850 square yards of macadamizing, and 5,000 cubic yards of earth and rock excavations. Bids received until Oct. 2.

RIVERS AND HARBORS.

Improving the Potomac Flats.—Washington Sept. 21.—Major Haines having submitted his plan for the improvement of the Potomac flats to the Chief of Engineers, that officer approved it and submitted it to the Secretary of War, with the recommendation that the work be done by contract by the lowest bidder after due advertisement for proposals. The plan was approved by Secretary Lincoln yesterday. Three objects are to be accomplished by the proposed improvement—the improvement of navigation, the establishment of harbor lines and the raising of the flats. The first of these objects is to be accomplished by dredging a channel from Easby's Point, near Georgetown, to near Giesboro Point, below the arsenal, and from Giesboro Point to Long Bridge, in the Washington Channel, of such a width and depth as will accommodate the largest class of vessels that can reach Giesboro Point.

The second, the building of a bulkhead which will commence near Easby's wharf and extend in a curved line to a point at or near the southerly end of the causeway of Long Bridge, thence continuing to a point at the intersection of the Washington and Georgetown Channels below the wharf of the United States arsenal, thence returning along the westerly side of the Washington Channel in front of the city wharves, and about 800 feet distant from them to Long Bridge. The third will be accomplished by depositing on the flats the material taken from the dredged channels, and such other material as it may be expedient to take from other places.

The estimated cost is $2,716,500.

RAILROADS.

To Begin Construction.—The construction of the new Michigan, Indiana & St Louis Railroad will shortly be commenced. It will be 166 miles in length and will run from Sturgis, Mich., to Danville, Ill., where it will connect with the Danville & East St. Louis road to St. Louis. The capital stock is $2,500,000. The officers of the road are: President, John Lee, of Crawfordsville; Vice-President, W. H. Beckwith, of Danville; Secretary, S. E. Thomas, of Michigan.

Mr. Jewett on the Erie Railroad.—"When I took charge of the Erie Railroad five years ago I said that it would require ten years of labor in it to make it even respectable for a man to be at the head of it. Five years have passed, and we have a railroad second to none in the country, and I think you will pardon my confidence," said Mr. Jewett, "that we now have the first railroad in the United States, notwithstanding the better financial condition in respect to dividends of our two great rivals. And in five years more," continued Mr. Jewett, his blue eyes dilating an instant, "I believe that we shall pay dividends on the whole of our stock regularly."—*Cincinnati Enquirer.*

Surveying a New Road in New Jersey.—A survey for a new railroad between Long Beach and Manahawkin has been made, so as to secure direct railroad communication with Long Beach and the several seaside resorts between Barnegat and Sea Haven. Surveys are also to be made for an air-line direct from Philadelphia to Long Beach. These roads will open an entirely new section of the New Jersey sea-coast.

New Road.—A railroad is to be built from a point in Coahoma county, opposite Helena, Ark., through Sardis, Oxford, Pontotoc east to Birmingham, Ala.

The Georgia Pacific has been completed from Atlanta to Ringer's cross roads, 45 miles. Nearly all the grading has been done between Ringer's Cross Roads and Anniston, Ala., and in October will begin the running of trains through to that place. All the rails have been ordered and are arriving daily, and the work on the road is being pushed as rapidly as possible. The work between Anniston and Birmingham is let and the contractors are getting on the ground every day, and soon the workmen will be swarming along the line. The 35 miles of the road east from Columbus to the line of Walker county have been let and work commenced. Thirty miles of the road have been completed from Greenville, Mississippi, to Johnsonville, and a branch road 20 miles long has been completed from Stoneville to Sharkey. A short piece of the line has been completed eastward from Columbus to Fern Bank. The entire road, from Atlanta to Greenville, Miss., will be 462 miles, and of that 263 miles have been let and partially completed.

Mexican Railroad Prospects.—Hon. John Bigelow has, in the October number of *Harper's Magazine*, an article entitled "The Railway Invasion of Mexico," in which he discusses at some length the prospects of the subsidized railroad now being built in Mexico by American companies and capital. He sums up as follows:

"1. Voluntary emigration cannot be relied upon to any appreciable extent.

"2. Railways must depend mainly upon the transportation of the products of Mexican industry, and of the purchasing power of its surplus in foreign markets. The railway business, therefore, cannot increase rapidly nor endure much competition.

"3. To make railways at all remunerative in Mexico they must be constructed and run with the closest economy and system. There will be no margin for extravagance or roguery.

"4. There are so many elements of uncertainty to be reckoned with in these investments, especially if made under the auspices and in the special interest of foreigners, that, while they would unquestionably prove highly advantageous to Mexico, and might ultimately prove highly remunerative to stockholders, at present they should be *caviare* to all who have not money to invest which they can afford to lose."

CONTRACTS LET.

The Sullivan Machine Company, Claremont, is getting out about $23,000 worth of machinery for the manufacture of asphalt pavement. This machinery will be shipped to Sidney, Australia.

Painting Contract Let.—The contract for painting the exterior of the White House and the exterior of the conservatory has been awarded to Fred. S. Newman, of Washington, for $1,254.80, he being the lowest bidder.

Contracts for the building of the Canton, Aberdeen and Nashville Railroad, will be awarded in sections of five miles each.

Award of Bids for Engravings.—The following named bids were opened at the Government Printing Office on Saturday last for engravings, etc.; Heliotype Printing Company, $25,000; Major & Knapp, New York, $20,824.65; Forbes, Boston, $20,000; Sinclair, Philadelphia, $16,873; Schœffel & Edwards, $12,835; Nan Arx, New York, $11,985; A. Hoen & Co., Baltimore, $10,285; Hartt, New York, $7,524; M. Joyce, Washington, $5,247.70. The contract was awarded to Sinclair, of Philadelphia.

The bids for the construction of a new penny bridge over Newtown Creek, in place of the one destroyed by the great oil fire last week, were opened by the Bridge Committee of the Supervisor's of Queens and Kings Counties. The lowest bid was that of S. A. Kelley for $26,000.

BUILDING.

Car Works Burned.—The Missouri Car and Foundry Works, in the southern part of St. Louis, were burned on the 15th. Loss estimated at $150,000.

Bids Received for Heating Apparatus.—The following bids were received for heating apparatus for the United States Court and Post Office, Philadelphia: Phœnix Iron Company, Trenton, N. J., $21,750; Bartlett, Hayward & Co., Baltimore, Md., $23,448; Hilles & Jones, Wilmington, Del., $26,443; John Baisley, Philadelphia, $33,128.25.

R. M. Kennedy, of Second and Wood streets, Pittsburgh, Pa., invites proposals for 200 frame dwelling houses.

BRIDGES.

There are over 1,400 bridges in the Illinois Division of the Wabash R. R.

MISCELLANEOUS.

Elevation Taken.—Mr. E. B. McNeill, civil engineer, has just taken the elevation of Litchfield, Conn. He finds it is 1,113.80 ft. above tide water.

A trial of the Fleuss Breather in the German coal mines has proved a decided success, and the German government propose to take the invention in hand and make it a leading feature in the Mining Exhibition, which will be held early next year in place of the one destroyed by fire this year. The address of Mr. J. B. Brown, agent for Fleuss, Duff & Co., is changed to 95 and 97 Liberty street, New York.

REVIEW OF CIVIL ENGINEERING PROGRESS.*

GENTLEMEN: Of all the important sections of the British Association, the one over which I have now the honor of presiding is, you will all I think admit at once, the most practical and most characteristic of the age. In future times, the present age will be remembered chiefly for the vast strides which have been made in the advancement of mechanical science. Other days have produced as great mathematicians, chemists, physicists, warriors and poets, but no other age has made such demands upon the professors of mechanical science, or has given birth to so many men of eminence in that department of knowledge. Though a member of the profession myself, I may venture before my present audience to claim that the civil engineer is essentially a product and a type of the latest development of the present century. Telford has admirably defined the profession of a civil engineer as "being the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbors, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns." This definition, written more than half a century ago, is wide enough to include all branches of engineering of the present day, although amongst those specifically mentioned the departments presided over by the railway engineer, the locomotive superintendent and the electrician will be looked for in vain. As Telford was beyond all question the most widely experienced and far-seeing engineer of his time, this little omission well illustrates and justifies my statement that the typical civil engineer of the day is a late product of the present century; for even Telford never foresaw the vast changes which railways, steam and electricity would evolve in the course of a few years

My predecessors in this chair have on several occasions stated their conviction that it was better for the author of an address to confine his attention to the particular department of engineering in which he had special knowledge than to wander over the whole field of mechanical science. A well-informed man has been defined to be a man who knows a little about everything and all about something. If you give me credit for being a well-informed engineer, I will endeavor to justify your good opinion by showing, while presiding at these meetings, that I know a little about steam navigation, and machinery generally; a little about iron and steel, and other manufactures, and I trust a good deal about the construction of railways, canals, docks, harbors, and other works of that class.

There have undoubtedly been published during the last fifty years many works of mark and merit, but the work which, above all others would, I think, have astonished and perplexed our ancestors, is the little one known to all the civilized world as "Bradshaw." This indispensable handbook of the nineteenth century testifies that the face of the country is dotted over literally with thousands of railway stations; that between many of these stations trains run at two-minute intervals, while the distance between others is traversed at a mean speed of nearly 60 miles an hour. The public are often justly indignant at the want of punctuality on some railways, but they should blame the management and not the engineers; for the daily conduct of the heavy traffic between England and Scotland shows, that, notwithstanding the constantly varying condition of wind and weather in this climate, a run of 400 miles can, on a properly laid-out railway, and with suitably designed rolling stock, be accomplished with certainty to the minute, if the management is not at fault. On the Great Northern Railway, for instance, of which I am consulting engineer, the 400 miles between London and Edinburgh is traversed in 9 hours, or, deducting the half-hour allowed at York for dining, at the mean rate of no less than forty-seven miles per hour including stoppages. A few months ago the Duke of Edinburgh was taken on the same line of railway from Leeds to London, a distance of 186¾ miles, in exactly three hours, or at a mean rate, including a stop at Grantham, of over sixty-two miles an hour. I know of no railway in the world where this performance has been eclipsed, and it will be, perhaps, both instructive and amusing to contrast with it the performance of the engines at the opening ceremony of the Liverpool and Manchester Railway, on September 15, 1830. A newspaper correspondent of the time, after describing many eventful incidents of his journey, proceeds as follows: "The twenty-four vehicles left behind were now formed into one continuous line, with the three remaining engines at their head; and at twenty minutes past five o'clock we set out on our return to Liverpool. The engines not having the power, however, to drag along the double load that had devolved upon them at a faster rate than from five to ten miles an hour (once or twice only, and that but for a few minutes, did it reach the rate of twelves miles an hour), it was past eight o'clock before we reached Parkside. Proceeding onwards, we were met on the Kenyon Embankment by two of the missing engines, which were immediately attached to the three which had drawn us from Manchester. We went still slower than before, stopping continually to take in water (query: to take breath), and creeping along at a snail's pace till we reached Sutton inclined plane, to get up which the greater part of the company were under the necessity of alighting and making use of their own legs. On reaching the top of the plane we once more took our seats, and at ten o'clock we found ourselves again at the company's station in Crown street, having accomplished the distance of thirty-three miles in four hours and forty minutes."

The incident of the passengers descending from a train headed by five engines to walk up an insignificant incline is, I think, worthy of being recalled to the remembrance of the traveling public, who are accustomed to see without astonishment a single engine rushing along with a train of a dozen heavy carriages at as high a speed as if it were running alone. We must do our immediate forefathers, however, the justice to remember that even they effected some considerable improvements in the speed of locomotion. For example, in 1763 the only public conveyance for passengers between London and Edinburgh was a single coach, which completed its journey in fourteen days, or at the average rate of 1¼ miles per hour. Strange as it may appear, there are at the present time many large fertile districts in Hungary where, owing to the absence both of road and water communications, a higher rate of speed cannot be attained in a journey of several days' duration.

An essential condition of the attainment of high speed on the railway is that the stopping-places be few and far between. The Great Northern express previously referred to makes its first halt at Grantham, a distance of 105 miles from London, and consequently but little power and time are lost in accelerating and retarding the speed of the train. In the instance of the Metropolitan Railway, on the other hand, the stations average but half a mile apart, and although the engines are as powerful as those on the Great Northern Railway, whilst the trains are far lighter, the average speed attainable is only some twelve miles an hour. No sooner has a train acquired a reasonable speed than the brakes have to be sharply applied to pull it up again. As a result of experiment and calculation, I have found that 60 per cent. of the whole power exerted by the engine is absorbed by the brakes. In other words, with a consumption of 30 lbs. of coal per train mile, no less than 18 lbs. are expended in grinding away the brake blocks, and only the remaining 12 lbs. in doing the useful work of overcoming frictional and atmospheric resistances.

Comparatively high speed and economy of working might be attained on a railway with stations at half-mile intervals, if it were possible to arrange the gradients so that each station should be on the summit of a hill. An ideal railway would have gradients of about 1 in 20 falling each way from the stations with a piece of horizontal connecting them. With such gradients gravity alone would give an accelerating velocity to the departing train at the rate of one mile per hour for every second; that is to say, in half a minute the train would have acquired a velocity of thirty miles an hour, whilst the speed of the approaching train would be correspondingly retarded without the grinding away of brake blocks. Could such an undulating railway be carried out, the consumption of fuel would probably not exceed one-half of that on a dead level railway, whilst the mean speed would be one-half greater. Although the required conditions are seldom attainable in practice, the broad principles should be kept in view by every engineer when laying out a railway with numerous stopping-places.

Nearly thirty years ago, when projecting the present system of underground railways in the metropolis, I foresaw the inconveniences which would necessarily result from the use of an ordinary locomotive, emitting gases in an imperfectly ventilated tunnel, and proposed to guard against them by using a special form of locomotive. When before the Parliamentary Committee in 1854, I stated that I should dispense with firing altogether, and obtain the supply of steam necessary for the performance of the single trip between Paddington and the city from a plain cylindrical egg-ended boiler, which was to be charged at each end of the line with water and steam at a high pressure. In an experimental boiler constructed for me, the loss of pressure from radiation proved to be only 30 lbs. per square inch in five hours, so that practically all the power stored up would be available for useful work. I also found by experiment that an ordinary locomotive with the fire "dropped" would run the whole length of my railway with a train of the required weight. Owing to a variety of circumstances, however, this hot water locomotive was not introduced on the Metropolitan Railway, though it has since been successfully used on tramways at New Orleans, Paris, and elsewhere. I am sorry to have to admit that the progress of mechanical science, so far as it affects locomotives for underground railways, has been absolutely *nil* during the past thirty years. The locomotive at present employed is an ordinary locomotive, worked in the ordinary way, except that in the tunnel the steam is condensed, and combustion is aided by the natural draught of the chimney alone, instead of being urged by a forced blast as on open portions of the line. Whether a hot-water, a compressed-air, or a compressed-gas locomotive could be contrived to meet the exigencies of metropolitan traffic is a question which, I think, might be usefully discussed at the present or some future meeting of the association.

A reference to the underground railway naturally suggests the wider question of tunnels in general. The construction of tunnels was not one of the novelties presenting itself to railway engineers, for many miles of tunnel had been driven by canal engineers before a single mile of passenger railway had been built in this or in any other country. To foreign engineers belongs the honor of having boldly conceived and ably accomplished tunnel works of a magnitude which would have appalled a canal engineer. I need only refer to the Mont Cenis Tunnel, over 7½ miles in length, commenced in 1857 and finished in 1870; the St. Gothard Tunnel, 9¼ miles in length, commenced in 1827 and finished in 1882; and the Hoosac Tunnel, 4¾ miles in length, commenced in 1854 and finished in 1875. In all cases rock of the hardest character had to be pierced, and it is needless to remark that without the aid of the machinist in devising and manufacturing compressed-air machinery and rock-boring plant the railway engineer could not have accomplished his task. Intermediate shafts are not attainable in tunnels driven through great mountain ranges, so all the work has to be done at two faces. In the case of the Mont Cenis Tunnel the mean rate of progress was 257 ft. and the maximum 400 ft. per month. In the St. Gothard Tunnel the mean rate was 429 ft. and the maximum 810 ft. In the Hoosac Tunnel the average rate was 150 ft. per month.

Tunnels under broad navigable rivers and estuaries have been a subject of discussion by engineers for at least a century, but the only one at present completed is the unfortunate and costly Thames Tunnel. Two important works of the class are, however, now well in band, namely the Severn Tunnel at Portskewet, and the Mersey Tunnel at Liverpool. Having reference to this fact, it will be interesting to quote the following passage from a letter addressed to the press by a Mr. Thomas Deakin on March 6, 1835, that is to say, more than forty-seven years ago. Mr. Deakin writes: "The Great Western Railroad from London to Bristol will be accomplished no doubt, and why not continue it under the Severn mouth, near Chepstow, Monmouthshire, through Glamorganshire, and to Milford Haven in Pembrokeshire? It would then traverse the coalfield of South Wales throughout its whole extent—a tract of country possessing also inexhaustible stores of ironstone. A tunnel was once proposed to be formed under the Mersey at Liverpool, and, had it not been for the failure of the Thames Tunnel would most probably have been carried into effect." It is not a little singular that the two tunnels thus forshadowed by Mr. Deakin should both be in hand at the present moment.

Undoubtedly the numerous accidents which occurred during the construction of the Thames Tunnel, together with its enormous cost of about £1,500 per lineal yard, and the eighteen years occupied in its construction, destroyed the chance of any other projected subaqueous tunnel for many subsequent years. One lesson enforced by the Thames Tunnel was the necessity of leaving a reasonable thickness of ground between the water and the tunnel. In the Severn Tunnel the minimum thickness is 40 ft., and in the Mersey Tunnel 22 ft. The width of river at the point of crossing at the former tunnel is two and a quarter miles, and the maximum depth of the rails below high water, 163 ft. In the case of the Mersey Tunnel the width is nearly three-quarters of a mile, and the depth 144 ft. The Thames Tunnel, as almost every one knows, was carried on by means of a special contrivance termed by Brunel a "shield." No special appliances have been adopted in the case either of the Severn or the Mersey tunnel. Both are driven in the ordinary way, but of course enormous pumping power is required and has been provided.

Where no special appliances are used in the construction of a subaqueous tunnel, it will be clear to all that an unknown risk is encountered. All may go well, and the engineer will then justly receive congratulations from everyone for his boldness and success. But, on the other hand, something may go wrong, even at the last moment, and I fear the engineer then would be abused no less roundly by the unthinking public for his temerity and consequent failure. It would be a "Majuba Hill" incident over again, and if the accident caused much loss of life the engineer probably would envy the fate of the brave but ill-starred General Colley, who at least fell with the victims of his rashness.

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* Address of Jno. Fowler, Mem. I. C. E., before the British Association.

In many cases of tunnels under estuaries, special appliances could be used which would obviate all risk and make the successful completion of the work a mathematical certainty. A tunnel under the Humber, about one and a half miles in length, projected by myself in 1878, the bill for which was subsequently passed by the Commons and thrown out by the Lords, was a case in point. The bed of the Humber is of very fine silt, and I proposed to build the tunnel in lengths of 160 ft., under the protection of rectangular iron caissons 160 ft. long, by 42 ft. wide, sunk by the pneumatic process. As the pressure of the air in the caissons would always be slightly in excess of that due to the head of water in the river, no interruption from influx of water could ever occur, and the operation of building the tunnel in lengths inside this huge diving-bell would be as certain and free from risk as the every-day work of sinking a bridge pier by the pneumatic process.

A tunnel over a mile in length now in progress under the Hudson River at New York is being driven through a silty stratum by the aid of compressed air, and with a certain amount of success, as only some twenty men have been drowned up to the present time. The principle upon which the compressed air is used is, however, a false one, since it is merely forced into the tunnel with a view to uphold the ground by its pressure, like so much timbering, and not to keep out the water on the principle of a diving-bell. It is clear, therefore, that the completion of the Hudson River Tunnel, if the present system be persevered in, is purely a matter of conjecture, and all we can do is to hope for the best. The same remark applies, of course, to the Severn Tunnel and the Mersey Tunnel, although in those cases the character of the ground is such that the contingencies are small in comparison with those encountered in the construction of the Thames Tunnel and the Hudson River Tunnel. Nevertheless, as I have already observed, unless special appliances of the nature of the pneumatic process be used, a subaqueous tunnel, whether it be the Channel Tunnel itself or one but a few yards in length, must necessarily present an unknown risk. The prototype of all these tunnels is the one commenced at Rotherhithe in 1809, which was successfully driven a distance of 900 ft. under the Thames, and failed when within little more than 100 ft. of the opposite shore. A tunnel about 1½ miles in length was commenced about ten years ago under the Detroit River in America, but was abandoned in a similar manner. So far good fortune has attended both the Severn and the Mersey tunnels, and there is, I am glad to say, every chance of its continuing.

That the series of mishaps with the Thames Tunnel, and the consequent postponement of all other projects for subaqueous tunnels, were due to errors in design and want of foresight on the part of the engineer is patent to every one now, and was foreseen by at least one acute contemporary of Brunel himself. Only a few months ago, when turning over the leaves of an old periodical, I became aware of the fact that a scheme, identical in all its main features with my Humber Tunnel project, had been suggested for adoption in the case of the Thames Tunnel, in lieu of the plan proposed by Brunel. Writing in December, 1823, or fifty-nine years ago, the author of the project, a working smith of the name of Johnson, says: "I propose to construct the Thames Tunnel without cofferdams by making it in parts, 28 ft. in length, each part having the ends temporarily stopped up, and being constructed on the same principle as the diving-bell. The men dig from the inside round the edge as if sinking a well, and throw the earth toward a dredger, the buckets of which work some feet below the bottom of the excavation. Each length will be suspended between two vessels and be conveyed to the place where it is to be let down." A description of the mode of connecting the several lengths is given, and I may add that the tunnel blocks had a sloping face to tend to bring the faces of the joints together, a plan since adopted with the huge concrete blocks at Kurrachee and other harbors. There is not a flaw in the design from beginning to end, as modern experience in the sinking of numerous bridge piers on precisely the same plan has amply demonstrated. It is beyond all doubt that if the design of this working smith had been adopted in lieu of that tendered by Brunel, the Thames Tunnel would have been completed in a couple of years, instead of eighteen years, and at a cost of about £300 per yard instead of £1,500.

If another tunnel be constructed under the Thames, which is far from improbable, as the requirements of below-bridge traffic necessitate some such means of communication, I venture to predict it will be built in accordance with the plan suggested fifty-nine years ago by the working smith, and not on that of Brunel's Thames Tunnel, or of any other tunnel yet carried out.

At the beginning of the present century a committee was appointed to consider the "practicability of making a land communication by a tunnel under the River Forth, at or near Queensferry." In a report dated November 14, 1805, it was recommended that a double tunnel should be constructed, at an estimated cost of £164,000, or at the rate of £30 per yard, exclusive of shafts and pumping. The surveyors reporting grounded their belief in its practicability upon the fact that Barrowstowness coal workings had been carried under the same Firth for a mile, and that at Whitehaven coal was worked for the same distance under the Irish Sea, in both places less water being met with under the sea than under the the land. The report concludes in the following words: "That a more easy and uninterrupted communication betwixt every part of a country increases the intercourse of commerce, arts, and agriculture, all must know. Ferries are still and often a formidable bar in the road. Of these in this country, the one under review at Queensferry is perhaps the most conspicuous. It is in fact the connecting point betwixt the north and south of Scotland, and, indeed, of the realm; and in this point of view the improvement of it must be considered a national object." These words are as true and applicable to the case in 1882 as they were in 1805. A ferry still is the only means of communication across the Forth at Queensferry, though the traffic has increased a hundredfold. Parliament, by the passing of the Forth Bridge Act during the present session, has given a practical recognition of the truth of the statement in the above-quoted report, that the improvement of the Forth passage is a "national object."

As you will receive a paper on the Forth Bridge from my partner, Mr. Baker, I will not trouble you with details of the proposed structure at the present moment. I may state, however, that after a careful consideration of the difficult problem, in concert with my able colleagues, Mr. T. E. Harrison, the Chief Engineer of the North-Eastern Railway, and Mr. W. H. Barlow, Chief Engineer of the Midland Railway, we unanimously advised the directors of the Forth Bridge Company to abandon the project for a suspension bridge, and to construct a steel girder bridge of the unprecedented span of 1,700 ft. The total length of the structure is 1½ miles, and it includes two spans, as aforesaid, of 1,700 ft., and two of 675 ft. over the navigable channels on each side of Inchgarvie. The execution of the work has been intrusted to me, and my intention is that the Forth Bridge shall be not only the biggest but the strongest and stiffest bridge yet constructed.

Although great navigable rivers offer the most serious impediments to lines of communication lying at right angles to the direction of the stream, and necessitate such formidable undertakings as the Forth Bridge, with a clear headway of 150 ft above high water, and the Severn Tunnel at a depth of 163 ft. below the same datum, still it must be remembered that such rivers were the earliest, and are yet the cheapest, highways for inland communication. Antwerp, the third port in the world, ranking only after London and Liverpool, owes its commercial importance undoubtedly to the Scheldt, which affords admirable water carriage for a distance of 60 miles from the sea-coast inland. London, similarly, is an inland port situated about 50 miles up the Thames; hence one-half of the distance between Antwerp and London is made up of fine rivers capable of being navigated by the largest ocean-going steamers. The practical result of the existence of this splendid line of natural communication is that iron girders and rails can be conveyed from the heart of Belgium to the metropolis at a far lower price per ton than from any iron-works in this country. Unfortunately, the southern coast of England and the opposite coast of France are indented by no such rivers as the Thames and the Scheldt, or we should never have heard of the horrors of the "middle passage" in "cockle-shell" boats, or of the Channel Tunnel.

To realize, however, the important part which rivers play in facilitating inland communication, it is necessary to glance at the other side of the Atlantic. In Canada, for instance, we have the great inland port of Montreal, where Transatlantic steamers anchor some 500 miles from the coast. The very term "stream of traffic" suggests a river, and the St. Lawrence well illustrates it. Into some small forest tributary of the Ottawa the lumbermen slide a log of timber, and many months after will that log, with thousands of others, forming together a huge raft, with huts upon it for the accommodation of the care-takers, be found pursuing its slow but ever-continuing progress down the St. Lawrence to Quebec, where it will be shipped to this country.

In Egypt for countless ages the "ship of the desert" and the boats of the Nile constituted the only means of communication. Wheeled carriages were practically unknown, although as long ago as 1832, Mehemet Ali bewildered the pilgrims by starting off for Mecca across the desert in a Long Acre barouche. But the Nile holds an exceptional position amongst the rivers of the world, for not only was it until quite recently practically the sole means of inland communication for the country through which it flows, but it was, and still is, literally the life of Egypt, since without Nile water there would not be a green spot in the whole of that now fertile land. Having filled the office of consulting engineer to the Egyptian Government for seven years, I have had occasion to give particular attention to the Nile, and I may state that in an average year that river conveys no less than 100,000 million tons of water, and 65 million tons of silica, alumina, lime and other fertilizing solids down to the Mediterranean. The Nile begins to rise about the middle of June, at which time the discharge averages about 350 tons of water per second, and attains in September a height of from 19 ft. to 28 ft., and a discharge of from 7,000 to 10,000 tons per second.

Napoleon the Great said that every drop of Nile water should be thrown on the land, and he was right so far as Low Nile discharge is concerned. The cultivated lands in the provinces of Lower Egypt have an area of 3 million acres, and to irrigate this effectually at least 30 millions of tons of water per day would be required, an amount somewhat exceeding the whole of the Low Nile discharge. At present the irrigation canals are totally inadequate to convey this quantity, and imperfect irrigation and consequent loss of crops is the result. In many instances a couple of men labor for a hundred days in watering by shadoof a single acre of ground, all which amount of labor might be dispensed with if the barrage of the Nile were completed, and a few other works carried out, the whole of which would be paid for handsomely by a water rate of 2s. an acre. You will gather, therefore, that I do not think the resources of Egypt have yet been fully developed, magnificent as they even now are, having reference to the size of the country.

It is hardly necessary to say that a network of canals laid out with a view to irrigating the lands of Lower Egypt can also be used at any time in the event of war for the offensive or defensive flooding of the whole or any part of the said lands. Except for the work of man, Lower Egypt for four months in the year would be simply the bed of a river, and for the remaining months a mud bank. Long before the historic period, however, the Nile had been embanked, and canals, such as the Bahr-Jusef, had been formed; the first, to keep the floods off the land, except in desired quantities; and the second, to run off the inundation waters as soon as the fertilizing matters in suspension had been deposited on the lands. Should the inhabitants of Egypt neglect to maintain the works of their ancestors, successive floods would quickly destroy the embankments and wash the light material into the canals. Thus the whole surface of the country would again be leveled, and the land of Egypt would revert to its primitive condition of being a river's bed for one-third of the year, and probably a malarious swamp for the remainder.

It is hardly possible to refer to Egypt without saying a few words about the Suez Canal. Far-seeing people, including the late Khedive, have long been of the opinion that another ship canal will be required in Egypt. In 1876 I submitted to His Highness, in accordance with my instructions, detailed plans and estimates for such a canal from Alexandria through Cairo to Suez. The total length of the canal was 240 miles, and with the same width as the existing Suez Canal the estimated quantity of excavation was 160 million cubic yards.

An interesting and significant incident in the history of the Suez Canal occurred in May, 1878, when a fleet consisting of ten steamers and sixteen sailing vessels passed through with 8,412 native troops bound from India to Cyprus. During the same year no less than 58,274 soldiers traversed the canal. Since 1878 events have marched rapidly, for no one then foresaw that the next important movement of British troops canal-ways would be of a nature hostile in appearance, if not in fact, to the inhabitants of Egypt. The announcement that French and not British troops were to hold the canal was received by the public with an expression of surprise and perhaps of slight resentment, because no one can dispute the vital importance of the work to this country. Periodically the question of the Euphrates Valley Railway is revived, and indeed quite recently I have had to reconsider the question professionally, but this route can never rival the existing one by the Isthmus of Suez.

The inauguration of steam navigation to India was much delayed by the vacillation of the authorities respecting the Suez and the Euphrates Valley routes. Happily, however, the Arabs stole the first bag of mails that went by the Euphrates, and so in 1834 a committee of the House of Commons finally resolved that "steam navigation between Bombay and Suez having in five successive seasons been brought to the test of experiment, and the practicability of that line being established, it be recommended to His Majesty's Government to extend the line of Malta packets to Egypt to complete the communication between England and India. Nothing appears to have been done during the next two years, but in 1837 a new paddle-wheel steamer, the Atlanta, of 650 tons, steamed out to Calcutta round the Cape in ninety-one days and was put on the Red Sea station. She left Bombay with the mails on Oct. 2, 1837, and arrived at Suez on Oct. 16. The mails were carried across the desert by camels, and down the Nile to Alexandria in four days, where they remained until H. M. S. Volcano took them on board on Nov. 7. At Malta, on Nov. 16, they were transferred to H. M. S. Firefly, and finally were landed in this country on Dec. 4, having been in all sixty-three days in coming from Bombay to England. At the present time about eighteen days are occupied in carrying the mails from Bombay via Brindisi to London.

The town of Southampton, where we are now assembled, has always held a distinguished position in connection with the development of improved communication with our Eastern empire. The opening of the first section of the railway from London to Southampton was coincident with the establishment of steam navigation via Egypt to India, and in the same year the French engineers at Cario completed their studies for the proposed railway across the desert of Suez.

A few months later the London public were startled by an advertisement headed "Steam to New York," and 91 passengers were plucky enough to embark at London, on April 4, 1838, in the Sirius, of 700 tons and 320-horse power, for New York, where they arrived on the 23d, having performed the voyage in seventeen days from London, and fifteen days from Queenstown. The Great Western sailed from Bristol on April 7, and arrived at New York a few hours after the Sirius, and thus was the great problem of steam navigation to America successfully solved, by vessels of small size, and capable of maintaining a speed of but eight to nine miles an hour. I need hardly remind you that since the year 1838 the ships conducting the enormous traffic between Europe and America have been of ever-increasing size and speed. Thus the Britannic, built in 1874, has an extreme length of 468 ft., a beam of 45 ft. 3 in., a displacement of 8,500 tons, and a speed of 16 knots per hour; whilst the Servia, built in 1881, has an extreme length of 530 ft., a beam of 52 ft., a displacement of 13,000 tons, and a speed of 18 knots, and the City of Rome, built in the same year, has a length of 600 ft., a beam of 52 ft. 3 in. and a displacement of 13,500 tons. Another Atlantic liner, the Alaska, having a length of 500 ft., a beam of 50 ft., and a displacement of 12,000 tons, attained a speed of 18½ knots on the measured mile, and has done the distance between Queenstown and New York in 7 days 4 hours and 32 minutes, and the return voyage in 6 days and 22 hours, a mean ocean speed of, say, 17 knots per hour, or more than double that of the first steam vessels trading to America.

The present generation has grown so accustomed to the embodied results of the progress of mechanical science, that it has long ceased to wonder at big ships, or at any other novelty. To realize what has been attained, it is necessary to place ourselves as far as possible in the position of our immediate ancestors, and to look at things through their spectacles. With this view, and to give you some scale of comparison to measure the size of the present Atlantic liners by, I will quote a short passage from a newspaper of September 19, 1829, where reference is made to a vessel then under construction, of about the size of one of the much abused "cockleshells" performing the Channel service between Dover and Calais. "The Dutch have been engaged for the last five years in constructing and equipping a steamboat of extraordinary magnitude, in order to facilitate the communication between Holland and Batavia. It has four masts; is about 250 ft. long; and has been appropriately christened the Monster. In consequence of her great length, she hung when going off the slips, and it was some days before she was fairy launched, a circumstance which gave the wits of Paris occasion to remark that their Dutch neighbors were so determined to excel all other nations in the magnitude of their steamboats that they had built one so long that it was several days running off the stocks. One of the most remarkable features of this enormous vessel is her extreme narrowness as compared with her length, her greatest breadth of beam being only about 33 ft. The great size of this vessel will bring to the recollection of our readers the Columbus, which was built in the river St. Lawrence in 1824, and made the passage to England in safety, but was afterwards broken up on account of her unmanageable bulk. We shall not be surprised to find that a similar fate awaits the Monster, and for a similar reason."

The Channel boat Albert Victor, now on the Folkestone station, is of the same length as the Monster, namely, 250 ft., whilst the beam of the former is but 29 ft., instead of what the critic of 1829 termed the "extreme narrowness" of 32 ft.

The successive attempts at mitigating the discomforts of the Channel passage by the swinging saloon and twin steamers of Sir Henry Bessemer and Captain Dicey have gradually prepared the way for what I believe will be the next and important step of establishing Channel communication by means of large floating stations, or ferry-steamers, capable of traversing the narrow sea between England and France in little more than an hour. Ten years ago I applied to Parliament for powers to carry out this project, and obtained the unanimous sanction of a committee of the House of Commons. The bill was, however, thrown out in the House of Lords by the casting vote of the chairman.

What was practicable at that time has now become comparatively easy, owing to the introduction of steel into shipbuilding, and the improvements which have been effected in marine engines and mechanical appliances generally.

Whether the over-sea or under-sea mode of crossing the Channel—the ferry or the tunnel—is to be the adopted scheme will soon be determined. It may be that both will be carried out, and then at least all tastes will be met, and all anticipations respecting the resulting increase in traffic, both in goods and passengers, between the two countries will be brought to the test of experience. However this may be, I am very pleased to be able to announce that my friends Mr. Abernethy and Mr. Clarke Hawkshaw will read papers on the subject, the former on the over-sea, and the latter on the under-sea plan, and I shall be disappointed if the papers do not lead to an interesting and valuable discussion.

In few departments of the engineer's work has such progress been made as in that of steam navigation. When in 1820 steamships were first used for conveying merchandise as well as passengers, the tonnage of the whole of the steam traders of this country, it is stated, amounted to but 505 tons. At the present time the corresponding figure is 2,500,000 tons. Did time permit I would say more on the subject, but I fear that in speaking at all upon steamships I have departed somewhat from my avowed intention of keeping within the sphere of engineering, in which I have chiefly worked. My apology must be that a discussion of railways led me to a consideration of tunnels and bridges, and this naturally suggested a reference to the rivers necessitating the construction of the said tunnels and bridges. From river traffic to ocean traffic is but a step, and so I have been insensibly led to touch upon the wonderful results achieved in recent times by naval architects and mechanical engineers.

I will not similarly err in troubling you with any remarks of mine upon the no less wonderful results achieved by electricians. A description of the work done by my friend Dr. Siemens during the past quarter of a century would in itself constitute a concise history of electrical science. Remembering, however, the warning of King Solomon, that "he who praiseth his friend with a loud voice, it shall be counted a curse to him," I will refrain from referring to Dr. Siemens, or to my immediate predecessor in this chair, Sir W. G. Armstrong, and conclude my address at once with a sincere wish that the present session of the British Association may prove not less interesting and productive of benefit to science than have any of those which have preceded it.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 328.)

CCLXXXIII.—ANNAPOLIS.

Annapolis, Maryland, in lat. 38° 45' N., long. 76° 29' W., is on the Severn River on undulating ground.

It was settled in 1620 and incorporated as a city about 1670. Water-works were built by a private company in 1866, after plans of Williams R. Hutton, C. E. The supply is procured from a number of springs and small streams, the water from which is collected in one stream and diverted by a dam into a circular well, whence it is pumped by two Worthington duplex steam pumps, one with 10-in. water cylinders erected in 1866, the other with 12-in. cylinders erected in 1881, lifting the water 125 ft. through a 10-in. cast-iron force main into a reservoir built in excavation and embankment, 127 ft. square at water surface and 16½ ft. deep, holding 1,250,000 gallons. The banks are puddled with clay and paved with granite. A brick trough is constructed 3 ft. under the bottom of the reservoir and covered with wooden slats ½ in. apart on which coarse gravel is laid, with layers of finer gravel on top, and a foot of sand over all. Through this the water filters, and is then conducted 4 miles to the city through a 10-in. main. This was at first of wrought iron and cement, which frequently broke and was replaced in 1879 with cast iron.

Distribution is by 7½ miles of wrought-iron and cement pipe of from 10 to 4 in. diameter, with 30 fire hydrants, 40 gates and 500 taps. There are 5 meters in use. The city pays $10 per annum for each fire hydrant. Service pipes are of galvanized iron.

The population in 1880 was 6,500. The daily consumption in 1881 was 250,000 gallons.

The capital stock of the company is $61,000. The works have cost $125,000. The bonded debt is $31,000 at 6 per cent. interest.

The expenses for the year ending March 1, 1882, were $10,957 66. Extraordinary expenses and repairs amounted to $6,017.36. The receipts were $16,209.73.

Alexander Randall is the President and Superintendent and James H. Hodges Secretary.

CCLXXXIV.—QUINCY, ILL.

Quincy, Illinois, in lat. 39° 57' N., long. 91° 25' W., is on magnesian limestone bluffs, 165 ft. above the Mississippi River.

Settled in 1821, it was laid out as a town in 1825, and incorporated as a city in 1840.

Water-works were built in 1873 by a private company after plans of Edward Prince, taking the supply from the river. A 20-in. cast-iron pipe extends into the river, conducting the water to a double-walled brick well. The water enters the outer well through a wire screen and passes around three-quarters of the annular space and then enters the inner well, 30 ft. in diameter. From this it is lifted 235 ft. by a Worthington compound duplex steam pump into a reservoir built in excavation and embankment 412 by 250 ft. and 22 ft. deep. The inner slopes are puddled and paved with a 16 in. dry stone wall. The bottom is puddled. The effluent pipe has flexible joints. This reservoir is recently built. The supply at first was pumped into two tanks holding 150,000 gallons. In 1877 a reservoir holding 5,000,000 gallons was built.

Distribution is by 20 miles of cast-iron pipes, of from 20 to 4 in. diameter, with 81 fire hydrants, 80 gates and 250 taps. There are 7 meters. The city pays $15,400 per annum for fire hydrants. Lead, enameled and galvanized iron service pipes are used.

The population in 1880 was 27,275. The daily consumption in 1881 was 750,000 gallons.

The capital stock of the company is $500,000. The works have cost $450,000. No further financial statements are given.

Lorenzo Bull is President, and Edward Prince acting as Superintendent during the absence of William B. Bull, the regular Superintendent.

The receipt of statistics, as follows, is acknowledged with thanks: From James H. Hodges, Secretary, statistics of the water-works of Annapolis, Md. From Edward Prince, Superintendent, statistics of the water-works of Quincy, Ill.

RAILROADS IN MISSOURI.—The seventh annual report of the railroad commissioners of Missouri has just been published. It states that seventeen new companies have been organized during 1881. The most important of these are the Kansas City, Springfield & Memphis road, from Springfield, Mo., to a point opposite Memphis, Tenn.; the Ozark Iron Mountain Railway, to run from the St. Louis, Iron Mountain & Southern in Washington or St. Francois County, in a southwesterly direction through Iron, Shannon, Dent and Texas counties, to an intersection with the Kansas City, Springfield & Memphis road in Texas County; the Chester, Iron Mountain & Western Railroad from Chester to Salem; the Salem & Little Rock Railroad from Salem to the South boundary of the state, and the Hannibal & Southwestern Railroad from Hannibal to Brownsville, in Saline County, and to the western boundary of the state. The largest number of miles of road built in any year was 580 miles built in 1871. The following statement shows the capital stock and debt on the 4,077 miles of road in the state:

Amount of stock reported	$102,185,700
An average per mile of road of nearly	25,000
Total funded debt on same	133,667,500
Average per mile nearly	33,000
Total stock and bond liabilities	234,918,200
Average per mile nearly	58,000

The number of companies operating railroads in the state is 25, but over 95 per cent. of the whole number of miles of road in the State of Missouri is controlled by ten companies, and over 50 per cent. by three companies. With regard to more than one-half of the railroad mileage of the state, the commissioners say there is no competition. At St. Joseph there are three interests, at Hannibal four, at Moberly one, and Sedalia one. There are 700 freight stations in the state, at 6 per cent. of which there is competition, and 94 there is no competition. The passenger rates for roads of the first class are 3 cents per mile, and for roads of the second and third class 4 cents per mile. The roads of the first class are given as follows: Chicago & Alton, from Louisiana to Kansas City; Chicago, Rock Island & Pacific, from Louisville to Leavenworth; Hannibal & St. Joseph; Kansas City, St. Joseph & Council Bluffs; Missouri, Kansas & Texas; Missouri Pacific; St. Louis, Iron Mountain & Southern, and the Wabash, St. Louis & Pacific.

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GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR..............ASSOCIATE EDITOR.

SATURDAY, SEPTEMBER 23, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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AMERICAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting of the Society on Wednesday evening, Oct. 4, Senor Don Francisco De Garay, Chief Engineer of the Drainage of the Valley of Mexico, will be present, and will explain and illustrate the methods and conditions relating to the above interesting engineering work. In view of the important industrial developments of Mexico, consequent on the railway building now progressing there, the subject is one of great interest, not only to engineers, but to the general public. Members of the society will please to invite their friends to attend this meeting.

THE AMERICAN INSTITUTE.—The fifty-first fair of the American Institute was opened on the 27th inst., at the fair building, Third avenue and Sixty-fourth street. Although the exhibits, especially in the machinery department, were not all in place, the number and importance promise to excel those of former years. The aim of the Institute is a most worthy one—to aid in the development of agriculture, commerce, manufactures, and the arts, and to encourage American industry in all its branches.

THE LATE STORM.—Undoubtedly one of the severest storms that has visited this section of the country for the past few years occurred during the last three days of the past week. New York city was the center and the damage done to roads, bridges, dams and crops within a radius of 200 miles cannot be estimated. The strong east and northeast winds, blowing continuously for several days, produced high tides which proved disastrous to works on the coast. The rain fell steadily and gently during Thursday and Friday and so completely soaked the ground that the outpouring that followed had no work to do but to change brooks and rivulets into torrents that swept dams and bridges before it. The Board of Freeholders of Union County, New Jersey, place the damage at $100,000, twenty-seven bridges needing repair or reconstruction. This is not an isolated case, but only one of many, as other sections in the same and other states suffered as severely. Many bridges upon the Rahway, Passaic and Raritan rivers were totally washed away. Travel was impeded on all the railroads leading into this city.

OBITUARY.

ASHBEL WELCH, President of the American Society of Civil Engineers, died at his home at Lambertville, N. J., on Monday, the 25th inst.

Mr. Welch was born in Madison County, this State, Dec. 4, 1809. He came of old New England stock, being seventh in descent from Governor William Bradford, of Plymouth. He was educated at the Albany Academy at the time Professor Henry was a teacher there, and began his professional career when 18 years old, under his brother, Sylvester Welch, who was then engaged on the Lehigh Canal in company with W. Milnor Roberts, Solomon W. Roberts and other engineers, who afterward became eminent in their profession. Mr. Welch soon became favorably known, and was intrusted with engineering undertakings of great magnitude and importance, and became one of the most prominent of the early constructors of canals and railroads.

In 1830 he became connected with the Delaware and Hudson Canal Company, and was in charge of that work for many years, building during that period the Belvidere Delaware Railroad. In 1852 he successfully accomplished an undertaking, the difficulty of which can only be appreciated by those who have had similar tasks—of doubling the capacity of the canal and locks within the period of three months, in the winter. This work was accomplished at a cost less than the estimates. From 1862 to 1867 he was Executive Officer of the Joint Companies in New Jersey, and assisted in effecting the consolidation of the Joint Companies with the New Jersey Railroad Company. Until 1871, when the Pennsylvania Railroad Company took possession of their lease, he was General President of the Associated Companies, and since then has been President of some of the roads and also of the organization known as the United Companies. From 1840 to 1845 Mr. Welch was engaged with Captain Robert F. Stockton in making the experiments that resulted in the building of the steamer "Princeton," the first propeller ship ever constructed in this country, and in the building and introduction of large ordnance. He devised a system of safety signals for railroads which is now extensively used, and an improved pattern of steel rails. Princeton College, in 1848, conferred upon him the title of A. M.

At the time of his death he was President of the American Society of Civil Engineers, to which office he was elected last January, and also President of the United Railroad and Canal Companies of New Jersey.

His funeral took place last Thursday from Lambertville, which has been his home for the past fifty years, a special train for the accommodation of members of the society leaving this city at 11:10 A. M.

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LITERATURE.

Rocks, Minerals, and Stocks. By Frederick H. Smith. The Railway Review: Chicago, 1882. 12mo. 234 pages.

Amateurs in geology and mineralogy, and engineers who turn to these subjects for recreation in their moments of leisure, will find this work one that gives in a handy shape and a popular style much interesting and valuable matter. The part on rocks tells how the world was evolved and how the strata were formed, and describes the various deposits. The part on minerals describes the most important ores and minerals, and tells how they are used in the arts. There is a good deal said about mines and mining. As miners are apt to speculate, a chapter on stocks is properly added at the end, in which the practices and tricks of stock dealing are explained. This chapter furnishes amusement as well as instruction.

Applied Mechanics. By Henry T. Bovey, M.A., Professor of Civil Engineering in M'Gill University. Montreal: 1882. Octavo, 150 pages.

About fifteen years ago the author of a book on roofs and bridges said in his preface that, notwithstanding that the subject of strains had been ably treated again and again, his design in writing was to supply a want long felt in the profession. Since that time many works have been written and published on the subject of strains, some of which have been able, and all of which have had more or less value, and yet the want of just the right kind of a book is still felt by engineers and by teachers in technical schools. And to supply this want new books are continually appearing. Bridge engineers look at the subject from one point of view, professors from another, and learners from one still different. The theoretical man looks at the subject of strains in a mathematical light, and often beclouds it with algebraic symbols: the practical man looks at it only as one of the least important steps in making the design. Owing also to the very deficient courses of instruction in elementary mechanics given in this country, students taking up such a topic come to it with very different degrees of capacity, and often find the authors shooting over their heads in the first half-dozen pages. Hence it happens that there always exists a want for a good treatise on strains, and hence so many new books are published and sold.

The work before us consists of six chapters—an introductory one on frames, one on roof trusses, one on bridge trusses, one on suspension bridges, one on arches, and the last on details of construction. The method of treatment is a combination of the graphical and the analytical, the latter being usually followed. The methods are explained in general, and no numerical examples or strain sheets are exhibited. There are, however, given over a hundred problems as exercises for the reader or student. The subject is everywhere presented very concisely, and apparently in a way such as a professor might lecture to a class which had had a thorough course in elementary mechanics and in the theory of the elasticity of materials. The specifications given on pages 72 and 73 for the tests of the materials used in bridges we refer to in particular as models of conciseness and clearness, as well as stating sound engineering practice. The value of the work, we think, would have been increased if the chapter on arched ribs had been omitted, and the space devoted to the numerical discussion of the common roof and bridge trusses. Very few engineers ever have anything to do with building a ribbed arch, and we doubt if many engineering professors ask their students to study its complex theory.

Professor Bovey has printed no preface in his book. A preface is usually an advertisement put in to lure the public and save trouble to the reviewers, and its absence shows that the author is willing to let the work rest on its own merits. This it is abundantly able to do, and while, of course, it does not satisfy the long-felt want, it may do as much to advance and protect the theory of strains as larger and more pretentious works.

Report on the Character of Six Hundred Tornadoes. By Sergeant J. P. Finley, Signal Corps, U.S.A. Washington: U. S. Signal Office, 1882. Quarto, 19 pages.

Tornadoes are usually regarded as of rare and infrequent occurrence, but this carefully compiled report shows that in the year 1881 alone there were in the United States as many as eighty-four, some of which were of a violent and destructive character. One in Mississippi destroyed twenty-seven buildings and killed ten persons; one in Missouri demolished eight buildings and killed nearly fifteen persons; one in Pennsylvania destroyed property worth $40,000; one in Kansas caused a loss of $150,000, killed five persons and wounded twenty-two; one in Minnesota caused a loss of about $400,000, killed six persons and wounded fifty-three; and so on through a long list. For the year 1880 over a hundred tornadoes are reported and described, many being very destructive. The one of April 18, in Missouri, for instance, demolished over two hundred buildings, killed sixty-five people, wounded two hundred, and caused a loss of over a million dollars.

Tornadoes occur most frequently in June or the summer months. More are reported from Kansas than any other State. They are most liable to occur during the afternoon hours of the day. They always move from the west toward the east. The velocity of progression of the storm cloud, as determined from the reports in 130 cases, varied from twelve to sixty miles, the average being thirty miles. The average time consumed by the cloud in passing a given point is about 6 5 seconds. The length of the tornado track varies from two to 250 miles, the average being twenty-eight miles. The velocity of the wind within the cloud vortex is variously estimated at from seventy to 800 miles per hour, the average being 392 miles. The rotary movement of the whirling cloud is invariably from right to left. Of the 600 tornadoes described, 134 are reported as unusually destructive. The least danger to life and property is on the left side, or north of the storm path. Very few wooden buildings will withstand the terrific whirl of the tornado cloud.

Bridge engineers usually allow about forty pounds pressure per square foot on vertical surfaces for the force of the wind. This is probably sufficient for all winds except those of the tornadoes. It would be impracticable, of course, to design the members of a roof or bridge to resist winds that are powerful enough to lift up the whole structure bodily, but we doubt if sufficient attention has been given to the general subject of wind action. Winds blow by gusts, and the action on the bridge is that of shocks of suddenly recurring intensity, whose effect is very different from that of the supposed static pressure of forty pounds per square foot. The Signal Office has done a good work in publishing this interesting and valuable report on tornadoes.

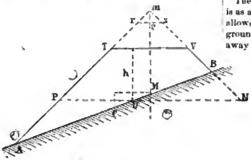

FIG. 1.

Van Nostrand's *Engineering Magazine* for October contains original contributions from William Paul Gerhard, Civil and Sanitary Engineer, Newport, R.I., on "House Drainage and Sanitary Plumbing;" from R. Randolph, C.E., on "Pile-Driving Formulas and Practice;" from Lieutenant H. H. Ludlow, Third Artillery, U.S A., on "Sub-Scales, including Verniers;" and from Professor William Cain, C.E., on "Trusses, with Superfluous Members." The price of single numbers of this magazine is fifty cents.

PERSONAL.

WM. MURDOCK, chief engineer of the Manitoba & Southwestern road, has been appointed to a similar position on the Souris & Rocky Mountain road.

J. E. TURK, chief engineer of the Valley Road (Ohio) has been appointed acting superintendent in addition to his present duties. Headquarters at Canton, O.

A **PARIS** dispatch of the 27th instant announces the death of M. **LELANCHÉ**, inventor of the Lelanché electric pile and other improvements in electricity. He invented the battery used with most of the telephones in the United States.

ENGINEERS AND ENGINEERING IN FOREIGN LANDS.

[Specially translated and prepared for ENGINEERING NEWS.]

METHODS FOR THE RAPID CALCULATION OF EARTHWORK.

A simple and rapid method for estimating earthworks is a *desideratum* for engineers, not that methods do not already exist that partially fulfill these requirements, but they do not apply as generally as might be desired. A communication from M. Pellis was lately read before the Engineer's Society of the Pays de Vaud (Switzerland) which will be of interest to engineers.

In some districts the profiles across a railway, canal or road line often present the natural lay of the ground in the form of a straight line, more or less inclined. A ground, on the other hand, that is naturally broken up may be often replaced by means of known methods, by a single straight line AB (fig. 1).

The theorem which we propose to demonstrate is as applicable to cuttings as to embankments, and allows us to replace the rectilinear and inclined ground AB by a horizontal ground, PN, which does away with the element of the slope of the ground, and consequently allows the surface of the earthwork to be found in a table with simple entry calculated beforehand in the function of the height of h—the correction being easily made by means of a second table, which will be also prepared before. The theorem is as follows:

Theorem.—Let M be the intersection of the axis of the platform with the ground AB, and let C be the middle of AB. The surface sought $ABVT$ is equal to the surface $PNVT$ (limited by the horizontal PN which passes through the point U—middle of CM) lessened by one-fourth of an isosceles triangles $M'rs$, the height of which is the difference in level of the points M and C, and its equal sides two lines $M'r$ and $M's$, having the inclination of the embankment slope.

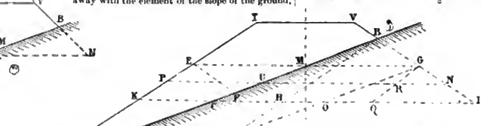

FIG. 2.

All that is therefore requisite is to determine the position of C, then that of U, which is done very quickly in practice. The vertical distances from U to the platform are then measured, and also those from C to M. The two calculated tables are then entered on by these vertical distances. Then the surface given by the second table is deducted from that of the first.

Demonstration (fig. 2).—The horizontal EG, which passes through the point M, leaves a trapezium, $ETVG$, above it, which is less than the surface sought by the triangle, AEF, obtained by drawing EF parallel to the slope VG.

On the other side the horizontal KI carried through the middle C of AB leaves the trapezium $KTVI$, which is greater than the surface sought for by a quantity equal to the triangle BHI, which is obtained by drawing BH parallel to the slope TA.

But $EF=BG$, as these lines belong to the two equal triangles EFM and MBG; if, therefore, we draw the line GL through G, parallel to the natural ground AB, to the point of meeting I, with BH prolonged, the two triangles AFE and LGB will be equal, and we shall have $BL=EA$. But we have also $HB=AK$, these lines belonging to the two equal triangles HBC and CKA; therefore, lastly, $LH=KE$, and by drawing GQ parallel to the talus TA we have:

$$LH=GQ,$$

from which we conclude that the angles LHO and GQO are equal, and that, consequently, the triangle AEF is equivalent to the trapezium $BHQG$.

Now the surface sought for $ATVB$ is the mean between the trapezoidal $ETVG$ and the truncated surface $KTVGQ$, since the one, $ETVG$ is less than it by a quantity equal to the trapezium $BHQG$, while the other, $KTVGQ$, is greater than it by this same trapezium. We can therefore put down:

$$\text{Surf. } ATVB=\frac{\text{Surf. } ETVG+\text{Surf. } KTVGQ.}{2}$$

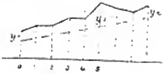

FIG. 3.

Or, again, by adding and subtracting a same quantity:

$$\text{Surf. } ATVB=\frac{\text{Surf. } ETVG+\text{Surf. } KTVGQ-\text{Surf. } PEGN;}{2}$$

Or, again:

$$\text{Surf. } ATVB=\frac{\text{Surf. } PTVN+\text{Surf. } PTVN-2\ \text{Surf. } RGN}{2}$$

or, lastly, superficies $ATVB$=superficies $PTVN$—superficies RGN, which had to be demonstrated; for the superficies of the triangle RGN is one-fourth that of the triangle QGI.

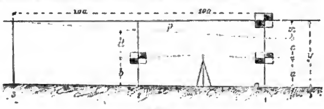

FIG. 4.

As the triangle RGN is generally very small with relation to the superficies $PTVN$, the correction may be omitted and the figure of the embankment $ATVB$ may be calculated in a rapid and practical way by looking on the plan for (1) the point G situated at an equal distance from the two extremities of the talus; (2) the mean point u between the axis picket and the point C. The offset for cutting or embankment is measured on this point u, and the corresponding superficies is found in the tables or calculated from the formula:

$$S=lh+fh^2;$$

l = the breadth of the platform and f the relation of the base of the talus to its height.

Application of Simpson's Formula.—Lalanne gave previously the following application of

Thomas Simpson's formula for calculating earthworks by finding the best line for equalizing between cuttings and embankments, by means of successive approximations. If the ground is not horizontal in the transversal sense, the heights between the formation level and that of the natural ground, which is found by the preceding method (fig. 3), may be used:

$$V = d\left[A\left(\frac{y_0 + y^n}{2} + \Sigma y\right) + 3\left(\frac{y_0^2 + y_n^2}{4} + \Sigma y^2\right)\right].$$

d = equidistance of the offset in even numbers.

A = breadth of platform of embankment or cutting.

Method for Adjusting a Fixed Level.

English surveying instruments being composed of an eye-piece and air bubble, the parallelism with the optical axis cannot be regulated by reversing as in the French instruments. The levels can be regulated, however, by the following method:

Three points, 1, 2 and 3, at equal distances, are determined on and marked by pickets. The verifying instrument is placed in the middle between points 1 and 2. The heights on the staff, a, are read off successively on point 1, and on b on point 2 (fig. 4). Whatever may be the error in level, or deficiency of parallelism between the bubble and the optical axis, the difference of level between points 1 and 2 will be $a - b$ or $b - a$. This done, the instrument is brought to point 3, and the staff heights on points 2 and 3 are taken again from the new station.

Let $a + b$ be the new staff reading on point 1, and $b + d$ the new reading on point 2, if we have $(a + c) - (b + d) = a - b$ or $c = d$, the level is right.

If the instrument is badly adjusted we shall have $d > c$ or $d < c$. The inclination p of the visual radius will be:

$$\frac{d-c}{h} \quad p; \text{ or } \frac{c-d}{h} = p;$$

h = the distance from point 1 to point 2, equal to that from 2 to 3. The parallelism of the bubble and the optical axis will be regulated by having the instrument give from station 3 at 1, a staff height equal to

$$y = a + c \pm 2\,hp. = om.$$

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RECENT INVENTIONS PATENTED DURING THE PRESENT WEEK.

STREET-RAILWAY CAR.

An inventor has recently constructed a street-railway car which is provided with an entrance at its front end, wherein a compound turnstile is rotarily secured under control of the car driver. The turnstile has appurtenant ratchets and pawls whereby rotation of the stile in either direction under control of the car driver is secured.

DREDGING MACHINERY.

In this invention a frame, consisting of a cross-head, guide rods and double plates bolted thereto, with interposed pulley and pole-socket extension pieces, supports inbearings in said plates, a shaft carrying a sleeve with end-stuffing boxes. Buckets are hinged to the frame by three pairs of arms, one pair turning on a common pivot near the bottom of the above plates, another pair on separated pivots at the top of the plates, and the third pair on a shaft screwing into plates sliding on the above guide rods and secured by bolts passing through filling pieces to plates on the other side of the guide rods. To the shaft is secured a lifting chain and also the chains first mentioned. This dredger belongs to the "clam-shell" pattern.

NOVEL VELOCIPEDE.

This invention consists of three driving-wheels placed in different planes, so that it will sustain itself in an upright position. This construction is secured by a suitable frame-work connected with each wheel. There are three seats perched over each driver in the same manner as the bicycle. Three sets of pedals are used, and it is adapted for three riders, one astride of each driving-wheel.

DEVICE FOR LOADING AND LANDING FLOATING LUMBER CRIBS.

In this invention a submerged railway is employed, and the car for receiving the floating lumber-crib is backed down the track by the locomotive under the floating lumber. A floating dock or guide is used, whereby, when the engine pulls the submerged car up the incline, the crib will be deposited on the truck.

SELF-LUMINOUS PAINT.

An English invention, patented during this week, and heretofore in nearly every country in the civilized world, consists of a luminous paint, the body of which is a phosphorescent substance, or composed in part of such substance, the vehicle of which is such as is ordinarily sized in paints, viz., one which will become dry by oxidation or evaporation.

SOCKET FOR INCANDESCENT ELECTRIC LAMPS.

This week the United States Electric Light Co. have assigned to them an invention, the object of which is to hold the lamp securely in the socket, and also to inclose and protect the circuiting springs. It consists of a rotary holder having a stationary base. Springs are employed capable of being brought into or out of electric contact with the terminals of the base by the rotation of the holder in one direction. The base and holder are both composed of insulating material, and incloses the conductors. A circuit breaker is located in the base.

F. B. Brock.

Washington, D. C.

CORRESPONDENCE.

ANSWERS TO GEOMETRICAL PROBLEM.

P. Y. & C. R. R., Pittsburgh, Pa.,
Sept. 18, 1882.

Editor Engineering News:

Several weeks ago Engineering News asked for the solution of a geometrical problem, viz.: From a point within an equilateral triangle the distances to each corner are respectively 20, 28 and 31 ft. What is the length of the sides of the triangle? The only answer to this question yet published is one from a correspondent who maintains that there is no mathematical solution possible, but gives an approximation, derived from a graphical process. And this seems to be passively indorsed.

By way of protesting against this conclusion I submit the following:

From the common point let fall perpendiculars to two of the sides of the triangle, and let one of them be produced until it intersects the opposite side. Let the base of the right-angled triangle formed by the produced perpendicular = b, and its hypothenuse = $a+z$; a being the distance from the angle of the equilateral to the perpendicular let fall upon it, and z the distance from this point to the point of intersection of the produced perpendicular. Let the other perpendicular = y. The right-angled triangle having y for base and z for perpendicular is similar to the other, and both are halves of respective equilateral triangles, the hypothenuse being twice the base, and the perpendicular $\sqrt{2^2 - 1^2} = \sqrt{3}$ times the base.

Let the side of the equilateral = x; then

$$x = \sqrt{\sqrt{903508} + 1072.5} = 44\ 98-$$

R. Randolph, C.E.

[F. Metler, C.E., of Keystone Bridge Co., Pittsburgh, gives same solution, $x = 44.9786$.]

K. & P. R. Extension.
Renfrew, Ont., Sept. 11, 1882.

Editor Engineering News:

I notice in last News, your correspondent Chas. J. Bates thinks there is not enough data given in Henry Thompson's problem of the previous issue. The following is the solution of the problem:

Let ABC be the given equilateral △, D the given point. In the case before us $AD = 28$; $DC = 20$; $BD = 30$. On AD describe an equilateral △ ADE and join EC. Then in △s BAD, CAE, $BA = CA$; $AD = AE$, and angle $BAD = CAE$, being each in deficiency of 60° by the amount of the angle CAD. ∴ $CE = BD$. Consequently in △ CDE we have three sides to find angle $CED = 40° 10'$. Then in △ CAE, $\angle AEC = 60° + 40° 10' = 100° 10'$, and $AE = 28$; $EC = 30$. Solving this triangle we get $AC = 44.49$.

M. J. Butler.

Newburgh, N. Y., Sept. 18, 1882.

Editor Engineering News:

The problem of the equilateral triangle proposed by Mr. Thompson, page 289, is susceptible of a mathematical solution. Let P be a point taken anywhere, and represent the distances from it to the three vertices, A B C, of an equilateral by a, b and c, respectively, of which let a be the greatest and c the least; and let x be one side of the unknown equilateral. We then have

$$\sin. \tfrac{1}{2}\ APB = \sin. \tfrac{1}{2}\ (BPC + CPA) = \sin. \tfrac{1}{2}\ BPC \cos. \tfrac{1}{2}\ CPA + \sin. \tfrac{1}{2}\ CPA \cos. \tfrac{1}{2}\ BPC.$$

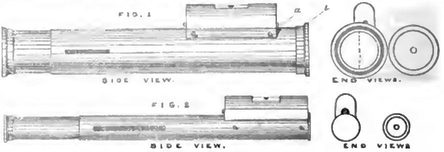
Substituting for these sines and cosines their values in terms of a, b, c and x, and reducing, we obtain the formula

$$x^2 \quad \tfrac{1}{2}(a^2 + b^2 + c^2) \pm \sqrt{\tfrac{1}{4}(a^2 + b^2 + c^2)^2 - (ab - c^2)^2 - (a-b)^2\{(a+b)^2 - c^2\}}$$

in which the + sign before the radical gives an equilateral containing the point, P, while the − sign gives another equilateral, as ABC', which does not contain P.

In the problem stated $a = 31$, $b = 28$, and $c = 20$; hence $x = 44.97808$; but for a point outside of the required triangle $x = 11.04410$.

Respectfully, W. H. Searles.



Improvement in Hand Levels.

IMPROVEMENT IN HAND LEVELS.

Cleveland, O., Sept. 18, 1882.

Editor Engineering News:

A recent examination of the hand level leads me to call attention to some changes and improvements that might be made in the article. A pocket instrument should be as light and small as consistent with the degree of strength and accuracy required. Those who have used the level designed by Locke know the advantage of having a large "field" brought quickly before the eye, that objects previously noted may be easily recognized, and the position of the level line fixed at once.

This feature, which is in itself very important, doubtless led to designing and giving to the trade a cylinder three-fourths of an inch, and a case an inch and a half in diameter.

Let any one acquainted with the instrument, or familiar with a telescope, and especially one who has learned that he is not obliged to keep one eye closed and the face distorted during an observation, take up a hand level, and, after carefully covering the object end so as to exclude all light from that direction, put it to his eye in the usual manner.

He will first observe that the quantity of light passing downward through the level tube opening has not been diminished, and that he can bring the instrument to a level position with as little trouble as before the end was covered. If then he will use both eyes, *naturally*, looking into the closed cylinder with one and in the direction of his work with the other, he will find before him a field of such dimensions that he ought not to complain, and beside which the half cylinder area would appear insignificant, and without further effort the closed cylinder and the bubble, and even the cross-wire, will appear to be transparent, thus permitting the center of the wire to be used in determining the position of the horizontal line, and insuring greater accuracy, as well as ease and comfort in using, than can be obtained in the ordinary manner, and for all, except such as have lost an eye, the instrument should be changed from its present form, shown in Fig. 1, to that shown in Fig. 2, both being natural size. The glass at the object end should be replaced by a metal cap; the tube and prism moved from a side to a central position; the half lens exchanged for a whole one, and the cylinder reduced in diameter as indicated.

It is difficult to understand why the cylinder was extended beyond the end of the level tube, from *A* to *B*, unless for appearance. The same increase in length at the opposite end would add something to the accuracy of the instrument.

H. F. DUNHAM.

TO FIND FROG DISTANCE AND ANGLE.

WELLAND, ONT., Sept. 22, 1882.

EDITOR ENGINEERING NEWS:

Would some of your correspondents kindly say if the following solution of the problem, "To find the frog distance and angle when the main line is curved," has been published.

AL = radius inner rail, main line, call it R.

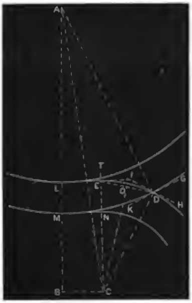
LM = gauge = g.

$MB = NC$ = radius inner rail of turnout = R'.

GDH = frog angle or angle between tangents = F.

ED = frog distance = d.

LE = switch rail; TE = throw. The length LE should be such as will give the necessary throw, say 5 in. when tangential to main line curve at L.



$MN = BC = LE = l$.

Now in triangle ABC, $AB = R + g + R$ and $BC = LE = l$ are known, and angle $ABC = 90°$, hence we know AC.

Now in triangle ACD we have from last the side AC, also $AD = R + g$ and $CD = R' + g$, hence we get angle ADC; but since ADG and CDH are each equal to 90°, the angle ADC is equal to $180° - GDH$ or $180° - F$; ∴ we have frog angle.

From the triangle ADC we also have the angle ACD. But angle $ACT = BAC$, which we have from right-angled triangle ABC, and angle $ECD = ACD - ACT$; ∴ we have ECD.

Now in the right-angled triangle EOC, $EC = EN + NC = g + R$.

Angle $ECO = \frac{1}{2} ECD$, but

$EO = EC \times \text{sine } ECO$; ∴ we know EO, also $ED = 2\,EO$, but ED is the frog distance—Q. E. D.

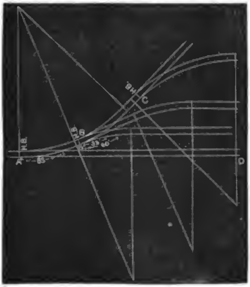
B. A.

STAKING OUT SWITCHES.

MEXICAN CENTRAL RAILWAY COMPANY,
LIMITED. ENGINEERING DEPARTMENT.
PASO DEL NORTE, Mexico, Sept. 19, 1882.

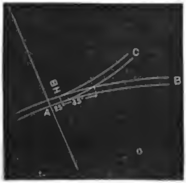
EDITOR ENGINEERING NEWS:

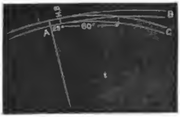
A correspondent "F. D.," in ENGINEERING NEWS of Aug. 26, asks: "What is the practical work for staking out a switch on the ground, frog being on the ground, and for the various ones now in use." Your issue of Sept. 9 contains an answer as general in its application as the question. However, this treatment of the subject is so different from the methods I have seen employed, that I venture to give a few cases of a different treatment.



Let us suppose *AB* the first siding in a yard, and the other lines a system of storage tracks. At *A*, we will use a split switch, at *B* a three-throw stub, and at *C* a single stub switch. We have on hand say frogs No. 9 and 6½, and empoly for a turn-out curve a 7° 30′.

First Case, A.—This being a split switch, we place the head block stake, marked *HB*, at the point of curve; or since the switch rail is not cut to a mathematical point, it is, perhaps, better to place the *HB* some eight feet inside the *PC*. It will be sufficient to place stakes every 50′ on the remeinder of the curve, and let the trackman curve the rails by his eye when he surfaces up.





The position of the point of frog, which we mark on the rail, is found as follows: The radius of the turn-out, less the gauge of the track, equals the cosine of the angle, which, divided by the radius, equals the cosine to radius one. This angle divided by the degrees of the curve and multiplied by 100 gives the lead to the frog.

Second Case, B.—Here we have a three-throw stub-switch. The switch rail, 30′ long, is spiked up 5′, leaving 25′ of moveable rail. At the free end is the head block; and the *PC* is supposed to be 25′ back. The throw of the switch 5″ differs from the ordinate of a 7° 30′ curve 25′ from its origin by $\frac{14}{100}$ of an inch, and the switch rail, taking a curve due to the elasticity of the steel and friction of the ties, differs slightly from a circle; but for all practical purposes it is part of the 7° 30′ turn-out.

Where two turn-outs, right and left, cross each other we use a 6½ frog, and find its distance from the head-block as follows: The two 7° 30 curves make the same angle with each other at the point of crossing as a 15° curve off a tangent. Therefore the radius of a 15° curve, less the gauge, divided by the radius, gives the cosine of the crossing angle. This angle divided by 15° and result by 100 gives the lead from the *PC*, and 25′ from this the lead from head-block. The No. 9 frogs, where the turnouts cross the tangent, will be located as in the previous switch. In staking out this switch I would place a track center at the head-block marked *HB*, another center at the middle frog marked *CF*, while at the long frogs I would place stakes *at* the frog points marked *PF* and track centers just opposite, not marked.

At the switch *C* put in a head-block stake, a center at + 50, another opposite the *PF* and a stake at the frog point.

When the turn-out is off a curve we can often use a No. 9 or 6½ frog in this manner.

Suppose *AB* a 3° curve. Add 3 to the standard turn-out curve 7° 30, and this gives the degree of the turn-out curve we must run off to employ a No. 9 frog.

To get off the 3° curve *AB*, on the other side, we use the 6½ frog, which fits a 15° curve off a tangent. The degree of the turn-out *AC* equals 15° less the degree of *AB*.

In the first case the lead to the frog is the same as for a 70° 30′ curve off a tangent, and in the second it equals the lead of a 55° curve off a straight track.

These points can be demonstrated by comparing the equations of the curves *AC* and *AB* with those of 7° 30′ and 15° curves crossing straight lines, if not by some easier method.

Yours respectfully, G. M. R.

NOTES.

SCIENTISTS DISCUSS LUDLOW WATER.

Charles Mayr read a paper on Ludlow water before the Springfield Science Association last evening. He gave a detailed topography of the reservoir, stating that the large reservoir contains too many shallow bays; that the water near the gate-house is very green, but almost odorless; that near the northwest end it is thickish green and has a slightly fishy odour; that near the Cherry Valley it is brownish but clear. In the Belchertown Reservoir it is very boggy, and a little current passes about 100 gallons into this smaller reservoir, which flows out at one gate. The speaker had analyzed the water frequently, and found the average to be about three grains of solids in a gallon. By analysis he found that filtering would remove about one-tenth of a grain from a gallon, this being the amount that now reaches the city, or about 40 pounds a day of algæ. This is a comparatively small amount, as the Ludlow pond might contain about six tons of the algæ. The trouble in the water, therefore, is in the pipes, since the water at Ludlow smells sweet, but arrives putrid at the faucets. The question, then, is, What is done in the pipes? Probably the algæ, stagnating and decaying in the pipes, produce the odor, for water without the decaying mass is odorless. Prof. Mayr recommends scientific flushing, so that even the smallest pipes may be cleared and supplied with filtered water. The filters will soon become fouled, and will have to be changed often. A discussion of the paper followed, participated in by City Engineer Ellis, who was glad to find substantial agreement as to the difficulty, and thought that flushing can be done in the best manner by proper flush-gates, and the matter in the pond best removed by filtering. Prof. Pillsbury suggested that it might be possible that decaying animals, instead of plants, produce the trouble. He thought the animal contained in the clear jelly-like balls so abundant everywhere produces something to rival Ludlow-water odors. Dr. Calkins says he has noted a decrease of typhoid since the introduction of Ludlow water and sewers, but in the case of the home of the friendless he had observed that little damage was done by the Ludlow. Mr. Ellis alluded to the fact that European cities, like Berlin, have the same kind of water in the reservoir, and yet furnish good water to the population by proper filters. At the close of the discussion a committee was appointed to draw up resolutions on the death of Dr. Lawton.—*Springfield Republican, Sept.* 14.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Rain-fall at the Croton Dam.—Complete returns of the recent rain-fall and its effects in the Croton Valley have not yet been received by the Department of Public Works, this city. The partial reports, however, showed that at the Croton dam the water before the storm was 18 in. below the top. Monday morning 41 in. of water was running over the dam, equivalent in one day to a thirty-five days' supply for this city. The rain-fall at the dam was 11.26 in., while at the reservoir in Central Park the fall was 13.18 in. The storm caused one or two wash-outs along the Croton pipe line, and the pipe was broken at Tenth avenue and Seventy-third street, but no damage was done that could not be quickly and cheaply repaired.

Price of Gas Reduced in Philadelphia.—The Gas Trust has decided to reduce the price of gas to private consumers, and to light the public lamps free of charge. The price to consumers will be $1.90 per thousand.

A Northampton, Mass., note says: Though the water question is pretty definitely settled till next summer, the commissioners propose to mature plans for another year, and are having estimates made for a new reservoir some distance above the present one. The farmers who own the little pond which it was proposed to turn into the brook hold it at a high price, and, as another reservoir would not cost very much, the pond may not be bought.

ELECTRICITY.

Electric Light in Passenger Cars.—It has been the intention of the Pennsylvania Central Railroad, for some time, to try the experiment of lighting its passenger-cars with electricity instead of gas. The first car equipped with electric light arrived at Philadelphia on the southern express Monday night. Seven lamps of the Edison pattern brilliantly illuminated the interior of the car. The electricity is supplied by a Faure's secondary battery, which is attached to the bottom of the car. The electricity is generated by a dynamo-electric machine and forced into the battery, where it is stored for use. In the battery used in making the experimental test sufficient electricity was stored to supply seven lights for seventeen hours. The light produced is about eight candle power, and is operated by a switch in one end of the car. The experiment was made under the direction of Mr. Lachlan, the electrician, who superintended the introduction of the light into the cars of the London, Brighton and South Coast Railroad Company in England. If the experiment proves a success it is the intention of the company to introduce the light in all its passenger coaches.

STREETS, DRAINAGE, ETC.

Keene, N. H., has contracted with the Drainage Construction Company, of Boston, for a complete system of sewerage, for $82,000. The total length of sewers will be between 12 and 13 miles.

The Hoboken Meadows.—For many years past the matter of filling in the meadow district of Hoboken has been agitated by the people of that city. Many meetings in favor of the project have been held, but no good has ever come of them. On Saturday last the district, which covers an area of about two miles, was completely inundated, and has remained so ever since, the residents being compelled to use boats or rafts to get to or from their homes. The matter of filling in the district was revived at the last meeting of the Common Council. Every member of the board was satisfied that something ought to be done, but they were unable to decide which would do the most good, the filling in or pumping systems, and they decided to have the matter voted upon by the people at the coming election.

Sewerage for Long Branch, N. J.—At a public meeting held on the 21st inst. an engineer explained that a main sewer could be built from North Long Branch to Green Pond, with two reservoirs and the pumps needed to force the sewage out to sea, at a cost of about $50,000. Dr. Thomas G. Chuttle, Dr. S. H. Hunt, R. J. Dobbins, D. M. Hildreth and Wilson D. Haven were appointed to prepare a report upon the necessity of sewering the town at once, the best plan of sewerage, and how to raise the money needed for the work, as the town has no power given in its charter to proceed with a work of the kind.

Alcona County, Mich., is considering a proposition to issue bonds for $30,000 to construct gravel roads.

The Potomac Flats.—The plan of Major Haines for the improvement of the Potomac Flats has been approved by the Chief of Engineers, and by him submitted to the Secretary of War, with the recommendation that the work be done by contract with the lowest bidder, after due advertisement for proposals. The plan was approved by Secretary Lincoln. Three objects are to be accomplished by the proposed improvement—the improvement of navigation, the establishment of harbor lines and the raising of the flats. The estimated cost is $2,716,509.

RIVERS AND HARBORS.

The Mississippi Levees.—A Memphis, Tenn., dispatch of the 25th says: The board of engineers to-day noon opened bids that had been filed for the repair of the broken levees on the Mississippi River. Proposals for the entire work had been received, but as yet no awards are made. The bids average 22½ cents per cubic yard for levees on the Mississippi side of the river and 25 cents for the Louisiana side.

Bids for Building Jetties.—The following bids have been received by Gen. Q. A. Gillmore at the Army Building this city for dredging and jetty building at the South: For dredging Wappoo Cut, South Carolina, the Charleston Dredging Company, at 16 cents per cubic yard for the first mile, 18 cents for the second, and 20 cents for the third mile. For the building of a jetty in the harbor of Brunswick, Ga., there were three bids, as follows: John C. Provost, 85 cents per square yard, $1 brush, $3.50 per cubic yard stone; James E. Walter $1.13 per square yard, 26 cents brush, $3.25 per cubic yard stone; William H. Adams, $2.20 per square yard, 50 cents brush, $3.75 stone. For dredging the Brunswick harbor, James E. Walter bid 27 cents per cubic yard for sand or sand and loam mixed, clay or shell, or marl stone. For the improvement of Volusia Bar, Florida, there were two bids—George A. Decotles, 95 cents per square yard for mattress, $5.96 stone per cubic yard, $8 each per piles driven; L. A. Cunningham, $1.05 mattress per square yard, $7.25 stone per cubic yard, $12 each per piles driven.

RAILROADS.

The New Mexico and Arizona Road.—The New Mexico & Arizona Railroad is now operated from Benson to Calabasas on the southern border of Arizona. This is the road which is to connect the Sonora road from Guaymas, on the Gulf of California, with the Santa Fe. The Sonora road is completed to Magdalena, a Mexican town about 60 miles south of Calabasas, and a stage covers the distance between the ends of the railroads, which are being constructed as rapidly as possible. It is expected that this gap will be closed up within 30 days. When the line is opened to Guaymas, nearly 1,700 miles distant from Atchison, it will be operated by the Santa Fe, and the line will be the longest railroad in the world under one management. The new line will also open the shortest route to Australia, 1,400 miles shorter than by way of San Francisco. The harbor at Guaymas is said to be one of the finest on the Pacific coast.

Rapid Railway Construction.—The swiftest railroad building ever done is now in progress along the line of the Canadian Pacific. The following are official figures of daily building, cover grading, track laying and bridging, all complete, with side-tracks, whose length is not counted. Here is the record:

Days.	Miles in decimals.	Days.	Miles in decimals.	Days.	Miles in decimals.
July 31	2.49	Aug. 14	3.40	Aug. 28	4.10
Aug. 1	3.85	Aug. 15	3.10	Aug. 29	3.50
Aug. 2	3.50	Aug. 16	2.72	Aug. 30	3.70
Aug. 3	3.94	Aug. 17	2.94	Aug. 31	3.60
Aug. 4	3.52	Aug. 18	1.66	Sept. 1	3.40
Aug. 5	3.35	Aug. 19	4.05	Sept. 2	3.60
Aug. 7	3.08	Aug. 21	3.35	Sept. 4	3.40
Aug. 8	2.76	Aug. 22	2.95	Sept. 5	2.30
Aug. 9	3.10	Aug. 23	2.85	Sept. 6	2.35
Aug. 10	2.61	Aug. 24	3.20	Sept. 7	3.35
Aug. 11	2.51	Aug. 25	3.50	Sept. 8	3.80
Aug. 12	2.90	Aug. 26	3.40	Sept. 9	3.20

New Line to Evanston.—The new Chicago & North Evanston railway has now secured the right of way from Evanston to the intersection of North avenue and Larrabee street. It is said that the Chicago, Milwaukee & St. Paul road has secured control of the company, and will build the road and run suburban trains from Evanston direct into the union depot on Canal street.

Track Laying Completed.—Track laying on the Nevada & Oregon Railroad was completed Sept. 18 to Roberts and Antelope stations in Long Valley, Cal., about 30 miles north of Reno, Nev., and regular freight and passenger trains commenced running from Long Valley to Reno, where connection is made with the Central Pacific and Virginia & Truckee railroads. The road will be extended this fall to Honey Lake Valley, and during 1883 to Goose Lake, at the Oregon State line. This road will run east of the Sierra Nevada Mountains through a well-settled country now without railroad facilities.

A New York Road Chartered.—The Binghamton & Williamsport Railroad Company, of Binghamton; capital, $400,000. The length of the railroad is to be 20 miles, and is to run from Binghamton to a point on the division line between New York and Pennsylvania, and thence by the most feasible route to Williamsport, Penn.

Railroads and the Money Supply.—It is estimated that fully ten thousand miles of railroad will be added to the facilities of the United States during the year 1882. This is exclusive of a considerable addition of lines in Canada and Mexico, in which American capital is interested; in the latter alone there are fully 2,500 miles under contract, and, taking the continent together, it is not unreasonable to suppose that we are under obligations for the cost of fully 12,500 miles of road this year, a greater extent next year, and so on as long as the supply of loanable capital holds out. Much of the road now building is in either the old and settled country or in the inaccessible wild West; some of it is double track, and most of it laid with steel rails, and an uncommon proportion of it in rugged and mountainous *terrain*. A fair estimate of cost would be not far from $25,000 per mile. This involves an outlay of from $300,000,000 to $350,000,000 per annum for a single form of internal transportation improvement. Can the country stand such a drain upon its industry and income? This is altogether a different question from that whether the expenditure is, on the whole, a provident one. We can, in one sense, afford it; but can we pay as we go? If not, can we get credit at fair rates? Where is the money to come from?

Road Graded.—Half the road from Doniphan to Neeleyville, known as the Doniphan Branch of the Iron Mountain, has been graded and ties and bridge timber distributed along the line. The road will be completed and ready for operation by the 1st of December next.

Road Incorporated.—The State Department at Harrisburg, Pa., has chartered the Phœnixville, Pottstown & Reading, and the Philadelphia, Norristown & Phœnixville railroad companies. The companies have a capital stock of $1,000,000 each, and both will be operated by the Pennsylvania Railroad Company.

A New Railroad Opened.—The Redstone Branch of the Pittsburgh, Virginia & Charleston Railroad was opened on the 25th.

Nearly thirty miles of grading have been finished on the railroad between Arcadia and Shreveport, La.

The Milwaukee & Lake Winnebago.—The Milwaukee & Lake Winnebago Railroad, being built in the interest of the Wisconsin Central, from Neenah to Milwaukee, is fast approaching completion, and will be ready for regular trains about Oct. 31. From Neenah to Oshkosh the road runs side by side with the Chicago & Northwestern; from Oshkosh to Fond du Lac the two roads do not diverge many rods at any place. From Fond du Lac the new road extends to Schleisingerville, and then runs into Milwaukee over the track of the Chicago, Milwaukee & St. Paul.

The Ottawa & Gatineau Valley Railroad, Ottawa, Sept. 27.—Arrangements have been completed by which Mr. Edward Bates Denny, President of the United States Mining and Investment Company, with its headquarters in New York, in connection with English capitalists, will undertake the construction of the Ottawa & Gatineau Valley Railroad. It is said that there is a scheme on foot to amalgamate this company with the Ottawa, Waddington & New York Railway & Bridge Company.

The Gunnison Extension of the Denver & South Park Railway has been completed.

Important Railway Lease.—Columbia, S. C., Sept. 24.—The Charlotte, Columbia & Augusta Railroad has leased the Chester and Lenoir Narrow Gauge Railroad for a period of 90 years. This road runs from Chester, S. C., to Lenoir, Caldwell County, N. C., a distance of 110 miles. Seventy-two miles of the road have been built and are now in running order. The lessees guarantee the completion of the line from the present terminus to Lenoir within 18 months from the date of lease.

CANALS.

A Canal Project in Germany.—A dispatch from Berlin says the Government intends to devote its attention to the execution of a project for the construction of a canal connecting the North Sea with the Baltic.

CONTRACTS LET.

Stone Contract Let.—The contract for supplying the curb stone for the approaches to the north wing of the state, war and navy department building at Washington has been awarded to Daves Tileston, of Rockland, Maine, for $53,648.

George H. Corliss, of Providence, has the contract to supply the pumps and engine for Pawtucket's, R. I., new pumping station. Two pairs of horizontal pumps, with a capacity of 1,500,000 gallons a day, will be set up at a cost of $21,000.

A Dredging Contract Let.—A Baltimore note of the 21st says: The United States Engineer's Office, in charge of the harbor defenses of the city, has been authorized by the proper department at Washington to enter into a contract accepting the proposal of a New York dredging company to dredge 2,500,000 cubic yards in the approaches to this harbor at sixteen cents per cubic yard.

Pump Contract Let.—St. Louis office of Henry R. Worthington, Frank H. Pond representative, has contracted to furnish the pumping engines, one million gallons capacity, for Tyler, Texas.

BUILDING.

Proposals for Bricks.—The Cincinnati Gas-Light & Coke Company will receive bids up to Oct. 14, for five million bricks.

LABOR.

The Board of Aldermen of this city have passed a resolution requesting Street Commissioner Coleman to pay his employés $2.00 per day.

BRIDGES.

Bridge in Lowell, Mass.—The City Council has voted to build a pile foot-bridge in place of the present floating bridge, to connect Centreville with the main city. Work has commenced on the piers of the new iron bridge, to replace the Central bridge, recently burned.

The work on the new bridge at Shreveport, La., is progressing satisfactorily. The bed of Red River at Shreveport, by the way, has filled in 7 ft. within the last week, changing from 21 ft. to 14 ft. of water.

THE CHANNEL TUNNEL.

BY J. CLARKE HAWKSHAW, C. E., M. A., F. G. S.

[Read before the Mechanical Section of the British Association Meeting at Southampton.]

This year the Channel Tunnel Company sought to obtain powers from Parliament to enable it to make a tunnel to connect this country with France by a railway beneath the Channel, and it deposited plans and prepared a bill for the purpose. The Southeastern Railway Company did likewise. Neither company obtained a hearing before Parliament; but there have been preliminary inquiries by the government, the results of which are that they have announced their intention of submitting the whole question to a select committee of both Houses, to be appointed early in the next session of Parliament. The Channel Tunnel Co. had proposed to make a tunnel beginning in Dover and passing beneath the shore line, about two miles eastward of that town, at Fan Hole, near the South Foreland. The Southeastern Railway Co.'s plans showed a tunnel beginning at the west end of the under cliff, which lies between Folkstone and Abbott's Cliff, and which was to pass beneath the shore line near Shakespeare Cliff to the west of Dover.

A Submarine Continental Railway Company was incorporated this year to purchase certain works belonging to the Southeastern Railway, consisting of two shafts sunk on the foreshore near Abbot's Cliff and Shakespeare's Cliff in the lower beds of the chalk and a mile or thereabouts of headings driven in the lower beds of the same formation.

The Channel Tunnel Company was incorporated ten years ago—in January, 1872—when it had already existed in the less ambitious form of a committee for four years, and it comprises among its supporters and advisers those who nearly 17 years ago carried out the first practical investigations, both geological and engineering, which were undertaken with the view to ascertain where and how a tunnel could be made underneath the Channel. Geological surveys were then made which determined the identity of the beds on the two sides of the Channel. The continuity of the same beds across the bottom of the Channel was determined by a sounding apparatus which brought up specimens from the bottom. The thickness of the chalk was obtained by borings 500 ft. deep made through it on the two coasts, and a machine made by Mr. Burnton for excavating chalk was tested and was found to work as rapidly and as efficiently as the machine lately used between Folkestone and Dover, of which so much has been said. All the geological work was done in the years 1855-67. The machine was tested in 1870.

Monsieur Thomé de Gamoud was the first engineer who worked at the geological part of the question. He proposed in 1866 to make a tunnel under the Varne from Folkstone to Cape Gris Nez through the Wealden and Oolitic formations.

For some years before this time Sir John Hawkshaw had been considering the practicability of a tunnel under the Channel, and early in 1865 he obtained the services of Mr. Day, an accomplished geologist, and who spent several months in that year in examining and surveying the cretaceous and underlying beds on the English and French coasts.

To supplement Mr. Day's work, in so far as it related to the Channel, Sir John Hawkshaw employed Mr. H. M. Brunel to take soundings across the Channel, and to ascertain, as far as possible, the nature of the material forming the bottom of the sea. An apparatus was devised for the purpose, by means of which specimens of the sea bed were obtained. It was found that instead of the sea bottom being composed of loose, transported material, it was mostly formed of rocks, *in situ*, similar to those seen on the adjoining coasts.

This marine survey carried out in 1865, 1866, determined the continuity of the upper cretaceous beds across the Channel. It was still necessary to ascertain whether the thickness of the lower beds of chalk which had been measured in the cliffs on both coasts where all the beds are exposed was maintained after the lower beds disappeared beneath the sea. Accordingly, Sir John Hawkshaw determined to bore through the chalk at two points on the English and French coasts respectively. In this costly operation he was assisted by the late Mr. Brassy, Mr. Wythes and Mr. Easton. The points selected for the boring was St. Margaret's Bay in England, distant four miles east of Dover, and about eight miles east of the out-crop of the lowest chalk beds on the coast, and Ferme Mouron in France 2½ miles east of Calais and four miles east of the out-crop of the same beds in the French coast. These borings showed that the thickness of the lower chalk does not diminish to any extent as we follow it eastward from the out-crop. In 1867 Sir John Hawkshaw prepared plans for the Anglo-French Committee in conjunction with Mr. Brunlees and M. Thomé de Gamoud, showing a tunnel from St. Margaret Bay in England to Ferme Mouron in France. In 1868 the Anglo-French Committee applied for a concession from the French government and a commission was appointed that year in France to examine the question. After various inquiries, and a long correspondence between the two governments, a concession was obtained in France in 1875, by which the French company were bound to spend £80,000. in preparatory works, the conduct of which was intrusted to a committee presided over by M. Lavalley, so well known in connection with the Suez Canal works. In addition to a new marine survey made by the company, a second boring was made at Sangatte, and the results of this work were published in 1876-77, in the form of reports with maps and sections. Since then the company have sunk two shafts a little to the west of Sangatte, and have driven some short headings in different directions through the lower beds of the lower chalk, and they are now driving two longer headings by machinery. This is being done for the purpose of defining the position of the gault and lower beds of chalk.

Since 1880 the Southeastern Railway Company have been carrying on experimental works between Folkstone and Dover. They have sunk two shafts, one near Abbot's Cliff and one near Shakespeare Cliff. A third shaft is being sunk to the east of Shakespeare Cliff. Headings have been driven, from the two first shafts, in directions more or less parallel with the cliff in the lower beds of gray chalk.

In a few words, the following is a summary of our geological knowledge of the question, as regards the chalk. Identical beds of chalk are exposed above the gault, in the cliffs on the two sides of the channel. These beds are on the two shores similar in composition, contain similar fossils and vary but little in thickness. Taken as a whole, they have a slight dip to the northeast. They have been found to pass uninterruptedly across the bed of the channel, on which the sections cut obliquely through them are exposed in bands stretching from shore to shore. Borings have shown that the lower beds increase rather than diminish in thickness as they dip below the sea level to the eastward of their outcrop.

Position and Line of Tunnel.—It will be necessary to assume certain requirements to be fulfilled by the tunnel before proceeding to discuss on what line it will be best to make it. I shall assume

1st. That it will communicate with existing railways in the ordinary way, by continuous railway ,and not as has been suggested by shafts and hydraulic lifts.

2d. It will be provided with a means of drainage by gravitation to the shore. That is, the water met with in the tunnel should be able to flow by gravitation from the summit level in mid channel to the shores of the two countries. This is necessary for safety during construction and for drainage afterward.

3d. The tunnel will be made for two ll way, and be so designed as to be capable of being worked by ordinary locomotives.

4th. The gradient will be nowhere worse than about 1 in 80.

5th. Geology has told us the kind of strata which will be met beneath the channel. The experience of engineers gained in past works can alone determine through which of these strata, and through what part of them, it will be best to pass. Before attempting to do so due consideration should be given to the following questions:

1st. What are the military requirements with regard to the tunnel?

2d. Where must the tunnel end inland, in order to give the best accommodation to existing railways?

3d. What are the most favorable strata for the tunnel works?

4th. On what line will any error in our geographical calculations be of least moment?

5th. Which is the shortest practical sub-marine line?

The points where the tunnel can pass under the shore line in France are limited by geological conditions to the part of the coast which lies be-

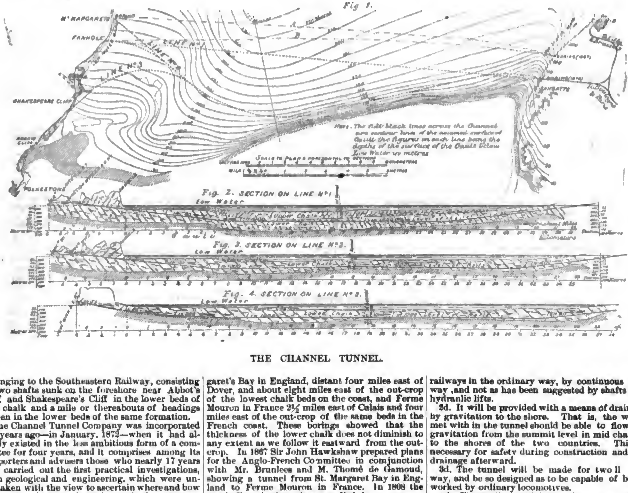


Fig 1.
St. Margaret's
Fanhole
Line No. 1
Line No. 2
Line No. 3
Shakespeare Cliff
Folkestone
Sangatte
A
B
Note. The full black lines across the Channel are contour lines of the assumed surface of Gault, the figures on each line being the depths of the surface of the Gault below Low Water in metres
Fig. 2. SECTION ON LINE No. 1
Low Water
Gault
Fig. 3. SECTION ON LINE No. 2.
Low Water
Fig. 4. SECTION ON LINE No. 3.
Low Water

THE CHANNEL TUNNEL.

tween the Ferme Mouron on the east (where the boring was made in 1867), and Sangatte on the west, a distance of about two miles. The country for some way inland throughout this distance is low and flat, and probably looking to military requirements, or to communications with existing railways alone, it is not very material within these limits where the tunnel first reaches the coast. The case is very different on the English coast. Geological conditions will admit of the tunnel passing under the shore line, any where between St. Margaret's Bay on the east and Shakespeare Cliff on the west, a distance of 4½ miles. With the exception of the valley of the River Dour, which enters the sea at Dover, the land along this part of the coast is high, bounded by chalk cliffs from 200 ft., to 500 ft. high.

Such being the nature of the coast there are only three places where the exit from the tunnel can be made: In the valley of the Dour near Dover, inland in the chalk escarpment to the mouth of Folkestone, and in the landslip between Abbots' Cliff and Folkestone; and physical and military considerations exclude the two latter. The exit at the first-named place can be placed at a moderate height above high water level, which means a shorter length of tunnel, and better gradients between the tunnel mouth and the lowest point of the line beneath the sea. It can be placed either within or without the fortifications, as the military authorities may require; and, as the existing railways terminate at Dover, they can with ease be connected by short railways with the tunnel line.

The plans deposited by the Channel Tunnel Company this session show the sea tunnel to begin at Fan Hole, which lies a short distance to the west of the South Foreland lighthouse. The first line laid down by Sir John Hawkshaw in 1867 left our coast at the same point. It was afterwards moved to St. Margaret's Bay, further to the east, and was so shown in the plans on which the French concession was obtained. In both cases the tunnel was shown to pass in a direct line to the Ferme Mouron in France.

Now, a line drawn from a point about half a mile to the east of Fan Hole to a point about half a mile to the west of the French works at Sangatte, is the shortest line between the two countries, measured from low water to low water, and is about 20½ miles long. From the Fan Hole to the Ferme Mouron, in a direct line, is 21½ miles, and from the same place to the boring made in 1876, near Sangatte, is 20¾ miles (line No. 1, Fig. 1, page 282). Practically, this last is as short a line as can well be obtained. For to move the point of departure eastward in England would be to lengthen the land tunnel in order slightly to shorten the sea tunnel, and geological conditions prevent our moving the line further to the west in France.

As we move the point of departure on the English coast to the west we increase the length of the most direct line to the French coast, and as we move it to the west of Dover this length is rapidly increased; for the tunnel cannot be made in a straight line from any point in England west of Dover, but must be made in a curve deviating considerably from the most direct line. Thus from Fan Hole, or thereabouts, the shortest line for the sea tunnel is obtainable; again, as Fan Hole is distant a little over two miles from Dover, it is, at the minimum distance, required to pass with a gradient of 1 in 80 from the mouth of the tunnel to the required depth below the shore line, and thus we get the shortest possible land tunnel. I think that so far it has been shown that everything is in favor of the tunnel terminating in the valley of the Dour and passing beneath the shore line near Fan Hole. It remains to be seen how far these advantages are outweighed by any geological conditions afforded by the Folkestone route.

The only reason which has been given for taking the tunnel under the shore line to the west of Dover is, that by so doing it can be made wholly in the lowest beds of chalk. It is asserted that no water, or very little, will be found in these lower beds. Now what are the facts? We are told that little water is found in the heading from Shakespeare Cliff. That may be so, as far as it has gone. In the headings driven at Sangatte, in the corresponding beds in France, water is met with flowing from fissures at the sides and bottom, and not confined to one place, but throughout the headings. The quantity which I saw was not large—the largest spring, perhaps, 30 gallons per minute—but it is enough to prove that those beds are not impermeable; and no one can assert that where small water-bearing fissures exist larger ones may not be met with. It is fair to conclude, from all available evidence, that, on the French side, water might be met with largely 60 ft. above the green-sand, or allowing 36 ft. for the depth occupied by the tunnel and its masonry, 24 ft. only above the tunnel, supposing it to be driven continuously along the top of the green-sand. On the English side, as the water is found only 32 ft. above the green-sand, the top of the tunnel would be in this water-bearing zone on the same assumption. It is needless to say that no railway tunnel could be driven along the top of the bed, following all its flexures. Thus, if the evidence from the permeability of the strata on land proves anything, it is that a tunnel driven in the lowest beds of chalk must come very near a bed from which large springs are discharged on land, and that it will probably have to pass into this bed. I may here remark that it is a fallacy to suppose that if a heading were driven across the channel in one bed, without meeting with water, it would prove that a tunnel could be driven on the same line equally free from water. The vertical depth of a heading is only 7 ft., that of the excavation for a tunnel would be at least four times that depth. In the Severn Tunnel works, headings have been driven in perfectly dry strata, yet, when the same have been enlarged for the full-sized tunnel, large quantities of water have been met with in the adjoining strata.

The work, which has tested to the fullest our power to tunnel through the wettest parts of the chalk is the Brighton intercepting sewer, for which Sir John Hawkshaw was engineer. The main sewer is more than seven miles long. The outfall is placed on the coast, about four miles to the east of Brighton; and, throughout a distance of about four and a half miles, a tunnel, from 9 ft. to 10 ft. in diameter, was excavated in the upper chalk, along the base of the cliff, and close to the shore. Being below highwater level, it cut through all the fissures which discharge the drainage of a large tract of inland chalk country. The greatest quantity of water pumped at one time was 10,000 gallons a minute, or 600,000 an hour; many other examples might be given, but none so striking as the above. It may be urged that, by going below the levels reached by the above works, more water would have been obtained, but that by no means follows. The Brighton sewer works must have intercepted most of the land drainage; by going deeper, some water, stored in cavities below sea level, might have been pumped. But the supply depends not on the quantity stored, but upon the rate at which the fissures can deliver it. Fissures there are, or they have been, at all depths; but, as the circulation is not so rapid in the deeper ones, they are more liable to be choked by sedimentary and crystalline deposits. Deep mines are often very dry ones.

Before leaving the subject of the quantity of water found in carrying out particular works, I will refer to two tunnels now in progress, although they are not being made in the chalk formation.

The Mersey Tunnel will connect Liverpool and Birkenhead by means of a railway. It is two and a quarter miles long, of which nearly three-quarters of a mile is beneath the Mersey. Shafts have been sunk, and a heading has been driven for a quarter of a mile, and the main tunnel for 600 yds. through the pebble beds of the new red sandstone. Mr. Brunlees tells me that the greatest quantity of water pumped amounted to 6,000 gallons a minute. This quantity is being gradually reduced by lining and tubing. The Severn Tunnel will be the longest railway tunnel in England, in all four and a half miles, in length; and it is the only railway tunnel which can claim to be submarine. It passes, for two and a half miles, below a tideway where there is a rise of tide of 40 ft., and a depth of water at high water of 90 ft. in the deepest part of the channel. It passes, for a considerable portion of its length, through the Permian red marl, which has many points of resemblance to the chalk. The marl, which is in nearly horizontal beds, is much fissured, and from these fissures, as well as from spaces between the planes of bedding, much water is discharged. At the English end of the submarine part of the tunnel, for some distance, there is only from 35 ft. to 40 ft. of this open-jointed red marl above the brick work of the tunnel, which is already finished where the cover is thinnest. Salt water flows freely into the work; and, to show how the water channels are disconnected, salt and fresh water have, in some cases, flowed from adjoining fissures, and the fresh water has been allowed to flow, for drinking purposes, through pipes built into the brickwork. The largest quantity of water has been met with on the land portion of the tunnel; and the largest spring met with was in the land tunnel. It discharged 5,000 gallons a minute, and burst suddenly into a heading, which had been driven for over 1,000 ft., in millstone grit, without meeting with any water. If the heading had been driven at a level of 10 ft. lower, the spring would have been avoided in the heading, but would have been met with when it was enlarged to the full size of the tunnel. The total quantity of water now being pumped is between 7,000 and 8,000 gallons a minute. The examples I have given show that engineering works need not be stopped, even by large quantities of water; and, much as we know of the chalk and its water-bearing qualities, there is nothing to show that water would be met with in such large quantities as to stop tunneling, even in the upper chalk with flints.

A tunnel can be made from Fan Hole, in a direct line to the French coast, wholly in the upper part of the lower chalk, without flints, as will be seen from the section of line No. 1 of the plan; but, as has been already stated, a tunnel could be made from the same place, if it were advisable, for nearly three-quarters of the whole distance, in the lowest beds of gray chalk. To do this, it would be necessary to curve the line of tunnel southwards after leaving the shore, and then eastwards, as shown on the plan in line No. 2. This would make the sea tunnel nearly one and a half miles longer on line No. 2 than on line No. 1. That is, the certain immediate cost of making one and a half miles of tunnel, with the prospective disadvantage of one and a half miles more sea tunnel, to work, maintain and ventilate would be incurred, to save the cost of possible excess of pumping on the one route over the other.

It is important to consider on what line an error in our geological calculations will be of least moment to our tunneling operations. The map and sections to which I have referred are all based on the result of the French company's work. The marine and geological survey was made with care and precautions, such as were probably never before taken, and is an admirable piece of work. As long as it deals with the surface of the sea bottom, the reports and accompanying plans and sections probably tell us a true story, on which we may rely. But when we pass from the surface of the sea bed to the strata beneath, we go from facts to conjectures. A longitudinal section down the centre of the Channel shows the chalk from where it begins, at the out-crop of the gault, dipping at first rapidly beneath the sea, the dip gradually diminishing as we go eastward. Now the part of this section in which error is most likely to be found is in the curve which denotes the base of the chalk near the outcrop. For the curve showing the base of the chalk depends not only on the position of the line on the map which shows the junction of the chalk and gault, which is, probably, in the main, correctly plotted, but also on the line which shows the junction of the two lowest beds of chalk of the French geologists (Craie de Rouen and Craie Moyenne). It would be very rash to take this last line as other than approximate, yet all it could tell us if it were correctly plotted would be the dip of the base of the chalk close to the sea bed, and even to get that we should have to assume the thickness of the Craie de Rouen from its ascertained thickness on the two coasts. Of the dip a short distance below the sea bed we really know nothing, and the curve indicating it must be imaginary. If the tunnel is to follow the lower beds of chalk it will have to be near this curve line, and any variations in the curve will necessitate deviations in the line of the tunnel, so that its length might be largely increased. This continual deviation of line would add much to the difficulties of construction. Again, the lower beds in which the tunnel is placed, and the nearer to the outcrops of those beds, the greater will be the risk of water finding its way along the planes of bedding from the outcrop. As we pass from the outcrop of the base of the chalk and the gault in an easterly direction along the Channel the chalk increases in thickness. On line No. 1 the chalk is 480 ft. thick, while on lines Nos. 2 and 3 it is only 235 ft. thick, and with the same thickness of chalk over the tunnel there would on line No. 1 be 245 ft. more below the tunnel. I have given a third section across the Channel along the line numbered 3 on the plan, and the position of a tunnel is shown on it in continuation of that shown on the section deposited by the South-Eastern Railway Company. This tunnel does not keep wholly in the lower beds of chalk, so that it does not fulfill the requirements which a tunnel beginning to the westward of Dover should. That it may do so one of two things must be done: the line of the tunnel shown on the plan must be depressed some 150 feet, so that it may follow the lowest beds across the depression shown in the section, or we must bend the line No. 3 shown on the plan more to the west, so as to follow the lower beds of chalk, where they are found at a higher level nearer to their outcrop. The first course would render it impossible to make a drainage heading to the shore in the chalk, for the tunnel would be so low at its lowest point that it would not be practicable to obtain a fall in the chalk to the shore. This drainage heading has been already stated to be a necessity. The alternative remains, but it would make the submarine tunnel at least one mile longer than line No. 3, which is already three miles longer than line No. 1 from Sangatte. That is to say, to avoid passing for a few miles out of the lowest beds of chalk, the total length of the tunnel would be increased by nearly four miles, beside incurring the other disadvantage of the Folkstone route. Four miles of sea tunnel would not cost far short of a million, an amount which would pay for 4,000 horse-power at work, night and day, pumping for nearly seven years—a power which would raise more than 40,000,000 gallons each twenty-four hours. In deciding on the best line for the Channel tunnel, the quantity of water which may be met with is but one of many factors to be taken into account. The Folkstone route would sacrifice all those of known value for the one of which the value is least certain. No tunnel will ever be driven under the Channel without meeting with some water, and an attempt to make one without ample preparations for dealing with a large quantity of water will only lead to waste of money and perhaps failure.

The following is a summary of the advantages to be obtained by making the tunnel in a direct line from Fan Hole to Sangatte: the shortest sea tunnel; as short a land tunnel as by any line; a greater thickness of chalk through which to tunnel; the best terminations for effecting junctions with the existing English railways; a termination affording facilities for defense at a less cost than elsewhere. No certain advantage can be claimed for the Folkestone route, and, as compared with the route to the east of Dover, it has the following disadvantages: The sea tunnel must be, at least, three miles longer; the land tunnel must be four miles longer, unless the mouth is placed in the Folkestone landslip; the chalk on the line of tunnel will be only half the thickness—in round numbers, 250 ft. against 500 ft.; it will emerge near no fortifications, nor can it be connected with the London, Chatham & Dover Railway Company's line at Dover; further, this tunnel must be made, for a great part of its length, near the outcrop of the chalk on the sea bed which should be avoided.

Ventilation.—It may be taken as an accepted fact that a Channel tunnel worked by an ordinary locomotive would require artificial ventilation. The matter was discussed at some length at a meeting of the Institution of Civil Engineers in 1876, when Mr. Morrison read a paper on the subject. Most extravagant estimates were then made of the number of horse-power required to ventilate the tunnel. The paper itself, and an account of the discussion which followed, will be found in the Minutes of the Proceedings of the Institution of Civil Engineers. If the attempt be made in a tunnel 20 miles long to create, artificially, a sufficient velocity in the air to maintain it in a state of even comparative purity, the difficulties will be found to be very great; but, if it be divided into sections, each five miles long, and these sections be treated separately, the difficulties, in a great measure, disappear. The distance between the ventilating shafts on line No. 1 would be about 21 miles; but to simplify the calculations, assume a tunnel 20 miles long, with descending gradients of 1 in 80 to points distant 5 miles from each shore, and rising from thence of 1 in 1,000 for the 5 miles to the center. The drainage headings, each with a falling gradient of 1 in 1,000 to the pumping shafts on the shore, will begin at the lowest points of the tunnel, midway between the centre and the shores where the two gradients meet. If the main tunnel be circular, with an internal diameter of 30 ft. and an area of 470 sq. ft. above rail level, air passages may be formed below the rails, having an aggregate area of 106 sq. ft. The drainage heading may also be circular, with an internal diameter of 17 ft., and a sectional area of 227 sq. ft. This will not be much in excess of what is required during the construction of the tunnel, for the greater part of the material excavated and materials for construction will be taken out and in through the drainage heading. If air is now drawn out of the drainage heading with a velocity of 10 miles an hour, it will produce a velocity in the tunnel of 2.4 miles an hour, supposing the air exhausted from the tunnel to be replaced at the shore ends from the shafts, and at the center from the air passages below the rails. If 48 trains pass through the tunnel in 24 hours, at intervals of half an hour, the air will remain pure at the shore ends and in the center. Between those points, the quantity of carbonic acid in excess of that normally contained in air, (3½ parts per 10,000 of air), will gradually increase, until it reaches a maximum at the points midway between the center of the tunnel and each shore, where it will amount to 12¾ parts per 10,000 in excess, or 16¼ parts altogether. The average condition throughout the tunnel will be 6.34 parts in excess, or 9.84 parts in all. Dr. Angus Smith, in his work on air and rain, states that in his own study he found 10.4 parts of carbonic acid per 10,000 parts of air. In theaters it has been found to vary from 20 to 32 parts; in the Chancery Court between 19 and 20 parts; and the air in a first-class carriage, between Gower street and Kink's Cross, with the windows open, contained 22.5 parts per 10,000 of air. Thus it will be seen that if such a state of things as is described above could be maintained in the tunnel, there could be no cause of complaint. To do this in a tunnel 20 miles long would require 460 effective horse-power, or 230 effective horse-power in each country. In a tunnel in a direct line between Fan Hole and Sangatte less than 500 effective horse-power would suffice. The cost of keeping this amount of horse-power at work would be a mere fraction of the working expenses of the tunnel, which, for many reasons, should not be as heavy as those of other nes.

COLONEL WARING AND PHILADELPHIA SEWERAGE.

In response to an invitation by the Finance Committee of Councils, Col. George E. Waring, of Newport, the expert and special agent of the Census Office, appeared before them last night that they might have the better opportunity to judge of the feasibility of the ordinance, now under consideration, which provides for his employment to inspect the sewerage system of the city and report plans for its improvement.

Upon being introduced by Chairman Clay, Col. Waring said that, except through private letters, he had had no knowledge of the ordinance until invited to attend the meeting of the committee. In response to inquiries by Messrs. Bardsley and Page, he soon, however, gave his opinion on the drainage of the city.

"I have been," said he, "since 1854, a drainage engineer, in constant practice of my profession, except during the war. I have examined all of the notable sewerage systems in Europe and America, and have tried to keep myself informed of the progress of my profession, and particularly in regard to whatever affected sanitary matters and the drainage of houses, cities and towns. I should not hesitate to accept the undertaking proposed in the ordinance, and I can say that, from what I already know, radical changes should be made in your present sewerage system."

"Is it probable," inquired Mr. Page, "that you would recommend the adoption of any patented system or appliances connected therewith?"

"If I come here," said Colonel Waring, "it will be as an engineer. In my experience in towns of minor size I found that the system of separate sewerage would best avail, and by certain additions to the apparatus and designs for such work I am now prepared to derive more than professional fees for my labors. There are parts of Germantown and other outlying districts where the separate system could no doubt be used with good results, but in the built-up portions of the city it would be impracticable."

WHY THE SEWERS BECOME CLOGGED.

"What are the most notable defects in our sewers?" inquired Mr. Bardsley.

"The examination upon which my report to the National Board of Health was based," said Colonel Waring, "was made by my Assistant Civil Engineer, William Henry Baldwin. Of course after a personal inspection I would be better able to answer. In the first place the condition of your branch sewers should be improved, and they should not be allowed to clog up. You are using in too many places a three-foot sewer where a twelve-inch pipe would do better service. Your fault is less one of design than of large sizes for small lengths. They should be of such a size that they would be thoroughly washed out by every heavy rainfall. Up to 18 in. diameter iron pipes are cheaper than brick sewers. Then again are the faults of bad construction and careless jointure. Sewers are mended and the débris which falls into them is left to dam up the flow and generate corruption and decay."

"Perhaps your greatest defect is the want of a proper responsibility in the department. One man designs the sewer, another builds it and the third cleans it out, or professes to clean it out. There is no one man who can control the system or to whom you can assign the blame for its defects. The refuse must soon be disposed of in another manner. The city cannot afford to have it discharging into the Delaware, where the flow of every tide carries it to the reservoir pumping station."

DEATH IN THE DRAIN PIPES.

"How about the ventilation of the sewers?" asked Mr. Hall.

"I would use neither street openings nor tubes," said Colonel Waring. "Each householder should be required to run the drain pipe which carries the sewage from his house up to the roof. It should be left untrapped, and then every discharge of sewage all through the city would be followed by a draft of fresh air. With such sewers as yours the impregnation of the soil by noxious gases is much to be feared. It would cost little more to make them fit to do the duty for which they are designed. They should be cemented inside and out, the joints tightly closed and the material of the best, and they should be kept clean. But defective house drainage exerts influences as baleful as do the most wretched sewers. The greater number of the cases of disease which doctors attribute to sewer gas is due to fault not in the sewers themselves, but to the filthy pipes which carry off the house drainage. Illuminating gas very often escapes from the pipes into the sewers, and most of the explosions are apparently due to that cause.

"The gas mains should not be permitted to run through the sewers. I see no objection, in so far as the purity of the water is concerned, in running the supply-pipes which carry a strongly-flowing stream through the sewers. Their gases cannot impregnate a strong current of water."

"But does not the comparatively low death-rate of Philadelphia show that her sewerage system is less defective than is commonly supposed?" ventured Mr. Bardsley.

HOW TO REDUCE THE DEATH-RATE.

"It shows nothing of the kind," quickly responded the engineer. "A low death-rate is no guarantee of good sanitary arrangements. You must remember the advantages of your healthful climate. You must bear in mind that here nearly every man rears his family in a home where air, light and sunshine are obtainable; that the tenement system is practically unknown. I judge your sewerage, not by your death-rate, but by my own ears, nose, eyes and knowledge. Perhaps if you enjoyed good drainage fourteen people might die where eighteen die now. It is the difference between your death-rate and your possible death-rate which must be considered.

"In New York, except in the older and lower portion of the city, the sewerage system is vastly better than here. The branches are small, tight, clean, washed out by every rain that falls. In Boston they are spending money by wholesale upon their main sewers, but their old branches are in worse condition than yours."

In response to an inquiry how he would conduct his examination in the event of the passage of the ordinance, Colonel Waring said that he would send Mr. Baldwin, his assistant, who made the former examination, to thoroughly inspect the sewers and to report to him the worse defects and best results of the system. He would then himself make a thorough inspection and would report the results, with his suggestions, to Councils.

On motion of Mr. Hall, the thanks of the committee were extended to Colonel Waring. The consideration of the ordinance was postponed pending the consideration of the appropriation bills.—*Philadelphia Times, Oct. 3.*

RECENT INVENTIONS PATENTED DURING THE PRESENT WEEK (OCT. 3).

MEANS FOR OPERATING DOORS OF ELEVATORS.

In this invention the doors are counterweighed to close them and opened by centrally pivoted levers on them, one end of which lever bears against the side of the shaft when a cam on the elevator rides against the lever, so opening the door. As the elevator leaves the door it leaves the lever in position to be operated by it on its return.

ENDLESS PACKAGE ELEVATOR.

This package elevator is composed and constructed of companion endless ropes, preferably of wire, connected together by and carrying a platform or a series of platforms, adapted to bear loads, and traveling around suitable pulleys provided at each terminus.

RAILWAY SWITCH.

An invention patented this week for a railroad switch comprises a shifting lever which is actuated through rotating spirally flanged treadles, one of said treadles being mounted in sliding bearings, whereby it can be moved out of the path of the wheel-flanges of the coming train when desired. The device is capable of operation by hand through a spring hand lever, which engages the connecting rod of the shifting lever.

FIRE-ESCAPE LADDER.

A folding fire-escape ladder is composed of wooden and iron side links, and tubular rounds and suitable metallic rungs or rods extending through the rounds and both sets of links, forming hinge joints.

UNDERGROUND CROSSING CABLE FOR STREET-CAR PROPULSION.

Where cables cross each other are placed inclined guide-ways, beginning below said cables and meeting at the point of crossing above said cables. The car is provided with a vertically sliding bar carrying on the bottom friction wheels adapted to travel on said guide-ways, and disengage the clutch from the cables.

SKELETON IRON STRUCTURE.

The sections of the pipe supports or columns are coupled together by couplings, through which pass bolts, which secure them to spiders or rings within the circle formed by said supports. The upper ends of the top sections are secured in a cap or head.

WATER OR GAS PIPE.

This new article of manufacture consists of an open-ended tube, comprising a sheet of metal rolled or overlapped to form the required diameter, and provided between the folds with solder suitably applied and adapted to set, thereby constituting a homogenous solid cylinder.

WASHINGTON, D. C. F. B. BROCK.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, OCTOBER 7, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondance upon subjects which naturally belongs to the province of this journal is solicited.

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THOSE WHO DID AND THOSE WHO DID NOT.—Elsewhere this week we publish the bids received by the Department of Public Works this city, for building a reservoir. No advertisement was inserted in ENGINEERING NEWS and but five proposals were presented. Fremont, O., and Orange, N. J., advertised in ENGINEERING NEWS for bids for building water-works, and each received proposals from more than 80 firms. A well-known bridge contractor recently told us that he had just returned from two bridge lettings. One bridge was advertised in ENGINEERING NEWS and there were 17 bids; the other was not and there were but 2 bids—the gentleman who told us the incident and another. They divided up the work. The above are only a few of the many facts we could give. Those who have contracts to let and those who wish to obtain contracts will be benefitted if they ponder well the above.

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THE REFORM OF THE SEWERS.

The members of the finance committee got a good deal of information gratis from Colonel Waring, but they ought not to stop here. A precise and detailed report from such an authority upon the existing faults of our drainage and their proper remedy would be of the utmost value and would be had very cheap at the sum it is proposed to appropriate. In a general way, of course, everybody knows what Colonel Waring told the committee about the faults and shortcomings of our sewers and of the shiftless system under which they are built and maintained, but this is a matter in which mere general knowledge will not avail. Indeed a chief source of trouble has been that one man's knowledge has been supposed to be as good as any other man's, and main sewers and branches have been built in a piecemeal fashion wherever or however a committee of the Councils or an individual Councilman, the Chief Engineer or a District Surveyor or a Highway Inspector thought best. We all acknowledge now that we have been going wrong, and no doubt every member of the Councils has his own separate idea of what measure of reform should be adopted first. Plainly, the only way out of the tangle is to call in some one who knows more than the rest of us, not only about general principles but about the practical details of drainage, and to have him tell us exactly what we ought to do.

Naturally the Chief Engineer of the city should be competent for his task, but it must be remembered that the subject of the scientific drainage of cities has become a very large one, which it is scarcely possible for any man to master in all its bearings unless he make it his special study and profession. It would not, therefore, be any reflection on Mr. Smedley, whose routine duties are enough to absorb his time, to call in a consulting engineer, even if so much of his own work, or work for which he is officially responsible, were of a part of the very thing that needs reform. In professional advice of any kind, the only safe rule is to get the best, and no one questions Colonel Waring's pre-eminence in the particular branch of his profession to which he has devoted a quarter of a century of study and observation at home and abroad, and in which he has attained important practical results. He is not the only authority on the subject, but he is doubtless the best, and, therefore, his recommendations would have a weight that would not attach to those of any resident engineer.

There is very little use of undertaking any extensive improvements in the sewers, however urgently required, without a clear understanding of what is to be done and how. We can all of us find fault, and all of us can make suggestions, each upon some small point that happens to have fallen under his own observation, but those amateurs who know the most will be the least forward with their own hobbies, and will best appreciate and value sound professional counsel. There is no subject pressing upon public attention here as important as this. Philadelphia ought to be not merely as healthy as other large cities, but very much more so, and we could spend money in no way to better advantage than in reforming our methods of drainage. But it is necessary first of all to know exactly what we have to aim at. There should be no more mere tinkering at the sewers.—*Philadelphia Times, Oct. 4.*

It was while the excitement of the "Trent Affair" was at its height that a prominent English journal gravely called the attention of the English government to the imminent danger of their Canadian possessions from the facility with which the Americans could march large bodies of soldiers during the winter over the frozen surface of Lake Ontario and thus capture Toronto, Belleville and Kingston. There are no people so loyal as colonists, and it was with a very visible tone of sadness that the Canadian journals commented on the deplorable ignorance of their "old country" contemporary. They were really ashamed of such an exhibit, where they felt only like deferring with unquestioning allegiance and respect.

It is with somewhat of the same feelings that intelligent people will read the above twaddle from so able and influential a newspaper as the Philadelphia *Times*, and this feeling cannot but be largely intermingled with surprise when they learn of the limited knowledge of sanitary matters that prevails in the second city of the Union, and the sluggish comprehension of a subject that is at the very foundation of their comfortable and healthy existence as inhabitants of a large, and in some portions overcrowded city. Now, any intelligent man—or woman either—who gives the subject a thought, would expect a city of nearly a million inhabitants to have a man at the head of its Public Works Department who knows what a sewer is, and what its proper shape and size ought to be to do its ordinary work properly and economically. But it appears by a memorial (see page 211 *ante*) to Councils that the beauty and efficiency of egg-shaped sewers was only "discovered" in Philadelphia a few months ago, and that too by a *lawyer* named Sanders, who very gravely submits a circular to the *Committee on Surveys* detailing the importance of his "find," and recommending an immediate invitation to Col. Geo. E. Waring, of Newport, R. I., to come on and tell them what *he* knew about egg-shaped sewers, and whether or not they would be good for Philadelphia.

So it is that Col. Waring has been giving a "good deal of information gratis" to the wise men of our sister city. "Gratis" information is a commodity that Col. Waring is not usually accredited with giving, especially to a city that can pay its politicians so well as Philadelphia does, and therefore it is that this statement will probably surprise some of Col. Waring's clients who know just what it costs to "invite" him to have a little talk with them about sewer systems.

"*Naturally the Chief Engineer of the city should be competent,*" etc. We should say so. "*No reflection on Mr. Smedley, whose routine duties are enough to absorb his time,*" etc. Political or engineering "duties?" "*Col. Waring's pre-eminence * * * * he is doubtless the best,*" etc. —— —— —— —— —— Where now are Worthan, Chesbrough, Adams, Joseph P. Davis, Towle, and Croes, of New York, Gray and Shedd, of Providence; and Whitman, Turner, Wise and Moore, of St. Louis, to say nothing of Philadelphia's own "resident engineer," whose "recommendation would not have the weight" of the "best" from Newport—Rudolph Hering, who at the present time may with propriety be called better than "the best" authority on sewerage matters, since he has had a practical experience equal to that of Col. Waring; he has spent as much time, and with equal if not superior advantages, among the great cities of Europe to examine their sewerage systems, and in point of value to engineers and to the general public, Col. Waring can point to no such invaluable records of his labor or research as Hering's "Report on the Sewerage of Philadelphia," and his Report to the National Board of Health on the Sewerage of European Cities. Col. Waring's record is principally in popular magazine articles; he is pledged to one system—the separate—he is the active man of a Sewer Construction Co., of Boston, and he has a patent sewer appliance to push for royalties. In his interview with the Philadelphia Finance Committee he told them *not a single new thing*. Mr. Hering has embodied it all in his report, and both Chief Engineer Smedley and his political associates know it as well as Col. Waring does.

Why does not New York City, or Chicago, or Cincinnati, or Providence call on "the best authority" to come and smell their respective street atmospheres and give him a show for a royalty? Why does not Newport, R. I., adopt the plans of "the best authority" instead of calling in Chesbrough to tell them how to build sewers. Col. Waring is a very active, intelligent engineer, and a writer of very charming magazine articles on sanitary subjects. But when a great metropolitan journal advertises him as the "very best authority" on sanitary subjects in the United States, we beg leave to take strong exceptions, and say that the Philadelphia journal is very much like its English contemporary on the subject of the great frozen lake—it does not know what it is talking about.

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ENGINEERS AND ENGINEERING IN FOREIGN LANDS.

(Specially Translated and Prepared for the ENGINEERING NEWS.)

The work on the Corinth Canal is now in full progress, and though the enterprise does not possess the same commercial importance as the Suez and Panama undertakings, nor their engineering difficulties, still it is viewed with great interest by European engineers. Periander, the tyrant of Corinth, Demetrius and Nero had an idea of cutting the isthmus. The remains of the work carried out by the orders of the latter are still not only visible, but well preserved. Demetrius had intrusted the Egyptians with the engineering works, but the race at that time was not that of the men who built the pyramids,

"Whose race was run
Before Antiquity begun."

They asserted that the level of the Gulf of Cornith was so much higher than that of the Gulf of Egina that the isles in the latter would be submerged if the isthmus was cut. The wily priests of Cornith also opposed the project. The trace adopted by the modern engineers is that of the ancients, and the wells and excavations of Nero's men will be utilized.

The climate is very warm, but tempered by the sea breezes, and thus the hygienic conditions are favorable. Mr. Gerster had charge of the survey of the three proposed lines.

The line No. 1 which has been adopted (Nero's) is 6,342 metres long measured on bottom; it is almost perfectly straight. But the rocks are high on each side, and the winds may be dangerous to navigation. The geological formation is mostly calcareous and sandy.

As the line is only six kilometres, no intermediate stations will be required. The transversal section will be of the same dimensions as the Suez Canal, viz: 22 metres at bottom, with a uniform depth of 8 metres below low water. The entrance will be protected by jetties. The maximum height of the cutting above the bottom will be 86 metres, 70 centimetres. Generally European engineers prefer a tunnel when the cutting exceeds 17 or 18 metres. The tunnel of Gabelbach, in Bavaria, is, however, 27.40 metres, and there is another of 32 metres. The Huehuetoca cutting in Mexico is, however, 50 to 60 metres deep for a length of 800 metres. As the vertical cuttings of Nero show few landslips, it is believed that the tapering of $\frac{1}{10}$ which has been adopted for the rock mass will be amply sufficient. There will be two bridges. The total cutting is estimated at 9,885,000 cubic metres, which will cost 2 francs per metre, or thereabouts. The work is to be completed in four years.

New works in India—one a canal of 93 miles to unite the rivers around Calcutta, and a partial revival of railroad and public works in most European countries—would seem to indicate very lively times next spring, provided no great contretemps ensues.

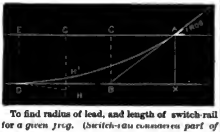
CORRESPONDENCE.

STAKING OUT SWITCHES.

St. Louis, Oct. 1, 1882.

Editor Engineering News:

In reply to the question in the issue of Aug. 26, in regard to laying out switches, I would like to give the method which has been used in our office, and which we find thoroughly practical, hoping it may be of use to some of your readers.



To find radius of lead, and length of switch-rail *for a given frog. (Switch-rail considered part of turn-out curve).*

In triangle ABC, having angle A = frog angle; CB = gauge. Find AC and AB. (1)

AB will be tangent of required curve = T and angle $ABX = CAB$ = frog angle will be the intersection angle.

Then formula $R = T \cot. \frac{1}{2} I$ (2) will give radius of lead (outside rail).

Dist. $AE = EC + CA = T + CA$ = dist. from heel of switch-rail to point of frog. (3)

To find length of movable switch-rail, to throw 5 inches (or any distance M).

In formula $d = \frac{C^2 \sin. D}{50}$ (Henck's Field Book sec. 19), value of d being given = 2 m (chord defl. = 2 (tang. defl.), transpose and we have

$$C^2 = \frac{d.50}{\sin. D}$$

in which C = length of switch-rail.

The actual field work consists of (after having located frog), measuring back a distance equal to EA to locate point where switch-rail should be left free, and then laying off the length of switch-rail to locate head-block.

If the turn-out is made from a curve but few modifications are necessary, W. P. B.

THE ASHEVILLE WATER-WORKS.

Asheville, N. C., Oct. 1, 1882.

Editor Engineering News:

In your issue of August 26 the following appeared:

"Asheville, N. C., is building water-works. C. L. Freeman, formerly connected with the Washington (D. C.) Water Department, is constructing Engineer."

In the Goldsboro *Messenger* of 29th ult. the following appears: "Work has been begun on the works for Asheville. The *Citizen* says there is an easily attainable supply for a population of 20,000 inhabitants." As I have received so many circulars and applications for a chance to furnish material, etc., I would state for the information of your many readers that I am only excavating on the side of a mountain of solid rock, for the reservoir, and I will advertise in Engineering News and *Sanitary Engineer* for proposals to furnish materials for the said work. In the meantime would like to receive catalogues and testimonials from the manufacturing fraternity.

C. L. Freeman, C. E.

THE METRIC CHAIN.

In camp in the State of San Luis Potosi,
Mexico, Sept. 16, 1882.

Editor Engineering News:

I trust that the gentle reader of Engineering News of August 26 was not beguiled into supposing that the singular experience of your correspondent, Mr. Kluegel, is representative of that of other American engineers in Mexico.

For a year past I too, like him, have used an alleged metric chain; but, unlike him, I am profoundly impressed by the importance of regarding the chain as a certain number of meters and not as an arbitrary unit in itself. My leveling rods are divided to centimeters, not to fractions of an arbitrary chain; and as I have to reckon gradients as a certain rise or fall per 100, it is plainly desirable that the length of the line be measured in meters. Width of road-bed, span of culverts, etc., are stated in meters, not in chains; and to compute the required cubic meters—not cubic chains—of earth-work and masonry there is a marked convenience in knowing the lengths along the line in meters. Again, we have frequently to state long distances from point to point in kilometers, which is readily done if lengths are recorded and stakes marked in dekameters and meters; but requires to be ciphered out, if the notes are made in chains independent of the meter. It is unnecessary to multiply illustrations such as will occur to any thoughtful engineer.

It seems to have entirely escaped Mr. Kluegel's mind that one great difference between system and confusion in metrology depends upon preventing each class in the community from setting up some unit of its own independently of other people. Why, for instance, do the arithmetics contain a mysterious apothecaries' weight table different from what is used in other kinds of business. The apothecaries of the United States, to their praise be it spoken, are now well on the way toward substituting the universal metric system for that old anomaly. Why do the arithmetics also contain a table of surveyor's measure, so-called, which is diverse from the length measure used by everybody except ancient surveyors and the U. S. public land officials? Why did they used to contain separate wine-measure and beer-measure tables, as if vintners and brewers could not agree upon the same?

Now, that these and other relics of the past are gradually disappearing before the present spirit of unification it behooves engineers here to use the same chain adopted by the world generally. It is 20 metres long, and it should be kept in mind that it is thus 20 times the primary unit of length; twice the secondary unit of the length, the dekameter, by which railroad line stakes should be marked, and $\frac{1}{50}$ of the kilometer, another secondary unit. F. B.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of the Society was held Wednesday evening, October 4th. Vice-President William H. Paine in the chair; John Bogart, Secretary.

The recent death of President Ashbel Welch was announced by the Vice-President, and appropriate resolutions were passed on the subject, providing also for the publication of a memoir in the proceedings of the Society.

Senor Francisco de Garay, chief-engineer of the drainage of the Valley of Mexico, then gave an interesting address, describing the topographical features of the City of Mexico and the valley in which it is situated, and giving a history of the various attempts, more or less successful, that have been made for centuries to drain this valley.

He also described the methods now proposed to be adopted to effect that purpose.

THE FORTH BRIDGE.*

BY B. BAKER.

At the request of Dr. Siemens, the following short paper on the proposed Forth Bridge has been prepared, though the author himself would have preferred to postpone any communication on the subject to the British Association until the works were well in hand, and the many points of interest and difficulties inseparable from so gigantic an undertaking had manifested themselves. At the present moment a commencement has not been made, the whole period from the revival of the project last year until now having been occupied in the necessary preliminary work of obtaining the Act of Parliament and preparing the designs and specifications. It is believed, however, that in a few weeks the contract will be let, and an energetic start will at once be made with the works.

Before referring in detail to the history of the undertaking and to the character of the design, the author would like to convey, if possible, some notion of the magnitude of the proposed bridge across the Firth of Forth. In preparing the detailed designs he has often experienced no little difficulty in realizing the scale upon which he was working. For example, the bed-plates for an ordinary railway girder bridge, say a couple of hundred feet span, would be about half the size of an ordinary dining-table, and it is difficult at first to picture to oneself a bed-plate about double the size of an ordinary dining-room, but that is the size of the bed-plate for the Forth Bridge girders. A diagram hanging on the wall shows the comparative sizes of some of the largest girders and arched bridges in the world, but even this fails, in the author's opinion, to impress upon the mind the vast difference in scale between the proposed and all previous bridges. On glancing through the last volume of "Reports of the British Association," with a view to obtain a notion as to the ordinary length of papers for section G, he incidentally obtained a notion also for illustrating in popular but perfectly accurate terms the size of the Forth bridge as compared with the largest bridges in the country. In the report of the Anthropometric Committee it was stated the average stature of a new-born infant is 19.34 inches, whilst the average height of the Guardsmen sent out to Egypt has been officially given at 5 ft. 10½ in. These figures have a ratio of 1 to 3.65, and, singularly enough, as the largest railway bridge in this country, the Britannia Bridge has a span of 465 feet, and the Forth Bridge a span of 1,700 feet, the ratio there also is 1 to 3.65. Hence, to enable any one to appreciate the size of the Forth Bridge, we have merely to suggest the following simple rule-of-three sum: As a Grenadier Guardsman is to a new-born infant so is the Forth Bridge to the largest railway bridge yet built in this country. Bridges a few feet larger in span than the Britannia have been built elsewhere, but they are baby bridges after all.

Such being the size of the structure, the question naturally occurs, why it should be necessary or expedient to build so unprecedented a work far north in this little island of Great Britain, when it has been found practicable to cover the globe with railways and to carry roads across the greatest continental rivers without involving any such difficult undertaking. The answer is a somewhat complex one. It is not the physical features of the country, but the habits of the population that render the construction of a 1,700 ft. span expedient. If the British public can save a few minutes by going a particular route, by that route will they go, although the alternative one might be as eligible, or even more so, in every other respect. This fact was forced upon the attention of the North British Railway Company nearly twenty years ago, when they sought powers to construct a bridge across the Forth, to secure for themselves and their allies, the Great Northern, Northeastern and Midland Railways, a fair share of the through traffic between England and the North of Scotland, which they alleged had been hitherto practically monopolized by the London and Northwestern and the Caledonian railways, whose route was a few miles shorter. Parliament, satisfied, no doubt, that the contention was a reasonable one, granted the solicited powers in the year 1865. The bridge then proposed crossed the Forth at a different spot to the present bridge, as the engineer had not the courage to face a span of 1,700 ft., and nothing less is practicable at Queensferry. Owing to the treacherous character of the foundations, however, it became necessary to adopt another site, and, by bringing the point of crossing five miles further down stream to Queensferry, a considerable saving in distance was effected in the route between Edinburgh and Perth.

The Act for constructing a bridge at Queensferry was obtained in 1873. At this point the Firth of Forth is divided by the island of Inchgarvie into two unequal channels, but the depth of water in each is such that a smaller span than 1,700 ft.

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* Paper read before the British Association.

could not be economically adopted for either channel. North of Inchgarvie the maximum depth of water is 218 ft., and south of the same 197 ft. In the former channel the bottom is of hard trap rock, and in the latter partly of rock and partly of extremely stiff boulder clay. It is not the treacherous character of the bed of the Forth, therefore, but the depth of water which precludes the construction of intermediate piers. Pneumatic apparatus is inapplicable to such depths as 200 ft., and no responsible engineer would care to found the piers of an important structure upon a bottom which he had no means of examining by diving apparatus or otherwise.

To the late Sir Thomas Bouch is due the credit of the bold proposition to cross the Forth in two spans of 1,600 ft., and to so avoid the necessity of intermediate piers in unprecedented depths of water, with all the consequent uncertainties and contingencies. A contract for the construction of Sir Thomas Bouch's great suspension bridge was made with Messrs. Arrol. and the preliminary works were in progress when the Tay Bridge fell. In consequence of the latter catastrophe, the directors of the Forth Bridge Company decided not to proceed with the works, and an Abandonment Bill was consequently promoted in the session of 1881. The North British. Great Northern, North-eastern, and Midland Railway companies, being interested in securing direct communication to the North of Scotland, objected to the abandonment of the enterprise, and instructed their respective consulting engineers, Mr. Fowler, Mr. Harrison, and Mr. Barlow, to report anew on the practicability and cost of crossing the Forth, either by a bridge or otherwise, at Queensferry or elsewhere. A careful reinvestigation of the whole question was accordingly made, with the result that the directors were advised that it was perfectly practicable to build a bridge across the Forth which would comply with all the requirements of the Board of Trade and public safety, and that the best place of crossing was at Queensferry. The Abandonment Bill, which had passed the Commons, was then withdrawn, and the engineers were instructed to agree upon a design. Modifications of the original suspension bridge were first considered, and Mr. Fowler and the author then submitted a project for a bridge on the continuous girdle principle. Mr. Harrison and Mr. Barlow, fully appreciating the advantages which would pertain to such a bridge, as compared with a more or less flexible suspension bridge, made independent investigations, and suggested several modifications. Finally, the design now before you (see cut) was unanimously agreed upon by all as the one to be recommended to the directors for adoption. The directors acted upon this recommendation, and, accordingly, the necessary plans were deposited, and an Act was obtained this year for constructing a continuous girder bridge across the Forth at Queensferry, having two spans of 1,700 ft., two of 675 ft., 14 of 168 ft., and six of 50 ft., and giving a clear headway for navigation purposes of 150 ft. above high-water spring tides. For this work Mr. Fowler and the author are acting as engineers.

It would probably be conceded by every one that a girder bridge would prove stiffer than a suspension bridge; but it is not so obvious that it would also be cheaper. Careful comparative estimates have, however, proved this to be so in the case of the Forth Bridge, and the reason is not far to seek. In a long span bridge the weight of the structure itself constitutes the chief portion of the load, whilst the pressure of the wind is at least as important an element as the rolling load itself, to carry which is the sole useful mission of the bridge. In a properly designed continuous girder for a long span bridge the mass of metal will be concentrated near the piers, where it will act with the smallest leverage and produce the least bending moment. In an ordinary suspension bridge, with stiffening girder vertically to provide for the rolling load, and horizontally to meet wind stresses, the mass of metal will be somewhat greater towards the centre of the bridge than at the piers, and consequently for a given mass the moment will be much less in the continuous girder than in the suspension bridge. Thus the Forth Bridge superstructure weighs but 2 tons per foot run at the centre of the 1,700 ft. span. and 13½ tons per foot run at the piers; whilst in a suspension bridge, as already stated, the weight of superstructure per lineal foot would be somewhat greater at the centre than at the piers. This consideration, coupled with the facts that suspension links are more costly than girder work, that a suspension bridge requires a very costly anchorage, and that the contingencies and risks during erection in a stormy estuary are very great, explains why, in such a case as the Forth Bridge, well-designed continuous girders form a cheaper, as well as a far stiffer, structure than a suspension bridge with stiffening girder.

Continuous girders, as a rule, are made of uniform depth, and it has been considered by some engineers a rather strained application of the term to so describe the Forth Bridge girders. But clearly it is the nature of the internal stresses, and not the external appearance of the girder, which should decide the question; and from this point of view the proposed Forth Bridge is in the strictest sense of the words a continuous girder bridge. By all authorities a beam is considered to be continuous if it is either rigidly or partially fixed as well as supported at each end in such a manner that a pair of equal and opposite couples act on the vertical planes at its points of support. In the case of the Forth Bridge, such continuity is attained by connecting together the ends of the two 1,700 ft. spans at Inchgarvie, and by projecting the other ends a distance of 675 ft. beyond the main piers, and weighting them to the required extent. The moment of the couples and the position of the points of contrary flexure in a continuous girder may be regulated at will, either by putting an initial stress on the girder, or by severing either the top or bottom member at the desired point. In the case under consideration the latter method has been adopted, and the question of the most advantageous position for the points of contrary flexure was a subject of elaborate investigation, as it was known to have a vital influence on the economy of the design. Having reference to all the conditions of the problem, it proved to be most advantageous to fix the points at a distance of 675 ft. from the piers, so that in effect the 1,700 ft. girder may be considered as made up of two cantilevers each 675 ft. in length, and a central girder 350 ft. in span.

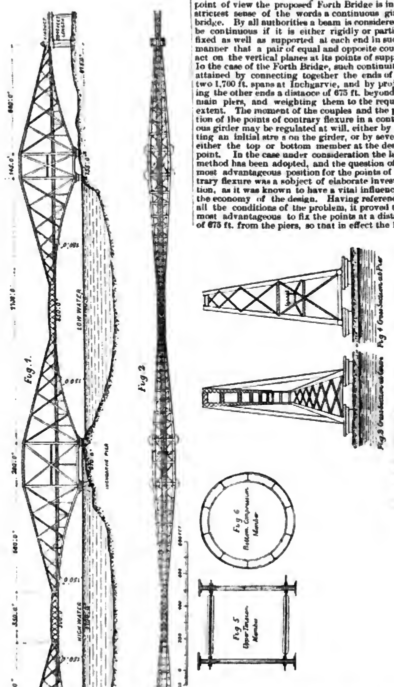
Fig. 1
Fig. 2
LOW WATER
HIGH WATER
Fig 4 Cross Section at Pier
Fig 3 Cross Section at Centre
Fig 6 Bottom Compression Member
Fig 5 Upper Tension Member

THE FORTH BRIDGE.

Similarly, on investigation, the most generally advantageous depth proved to be about 50 ft. at the centre, and 350 ft. at the piers; and, this being settled, the next thing to be determined was the most advantageous width for the superstructure. Since the fall of the Tay Bridge, engineers generally, and the Board of Trade in particular, have vividly realized the fact that the severest wrench to which a railway viaduct is subject arises not from the vertical stress due to the loading of both lines of rails with locomotive throughout, but to the diagonal stress due to the combined action of the ordinary rolling load and a violent hurricane. In the case of the Forth Bridge this stress would act at an angle of about 45 degrees, so that, were it not for the dead weight of the structure, the required strength would be the some horizontally as vertically, and the economical width would be the same as the economical depth. Although the dead weight modifies this conclusion, it was obvious that the bridge should be a continuous girder of varying depth on plan as well as on elevation, and investigation showed the economical width of superstructure to be about 32 ft. at the centre, and 132 ft. at the piers.

It was open to consideration whether the wind stresses should be resisted by bracing together both the top and bottom members of the girder, or the bottom members alone. The author, however, never had any doubt that, as the stresses must sooner or later be brought down to the masonry piers, they had better be brought down at once by the shortest route along the bottom members only. The top members are therefore spaced at the distance of from 33 ft. to 27 ft. apart, centre to centre, and are unconnected by wind bracing. Each of the main vertical and diagonal struts consists of a pair of tubes spread out at the base like a bridge pier, and the wind stresses on the bracing between the tubes are much reduced thereby. In like manner are the wind stresses on the bracing of the bottom member reduced by the spreading out of the legs of the cantilevers, and the general stresses on the web members by the tapering depth from the piers towards the ends of the cantilevers.

Having thus blocked out the general outline of the girder, so that the shearing stresses from the diagonal action of the wind and load should be largely taken up direct by the main members, the next point was to determine the number of bays, and the angle of the web bracing. It was not infrequently assumed that 45 deg. was the most economical angle, but this was true only when the admissable stress was the same in compression as in tension, which was not the case either with wrought iron or steel, or where, as in the instance of wind bracing, the diagonals were subject to alternate compressive and tensile stresses. American bridge builders, as a rule, disposed their long slender struts vertically, and their diagonal ties at an angle of 45 deg., and as the question of competition entered into the problem, it might safely be assumed that economical considerations dictated this arrangement. The general slope of the web members of the Forth bridge was something between the angle of 45 deg. and the vertical, and, although the author was not prepared to contend that the disposition adopted was the most economical attainable, yet he was satisfied that it reasonably approached that limit.

Whatever the angle of the bracing, it was quite clear that, in a girder of 1,700 ft. span, exceptionally long struts would have to be provided, and it was a matter of much importance, therefore, that the struts and compression members generally should be of the most economical and efficient form. The advantages offered by a circular form of cross section were self-evident. A flexible sheet of drawing-paper, simply rolled upon itself, becomes transformed into a stiff column, as every one accustomed to handle plans and drawings well knew. Similarly, a thin sheet of iron or steel, bent into a tubular form, without further stiffening, offered as high a resistance per square inch to compression as the most heavily braced rectangular strut. The author recently tested a piece of ordinary stove-pipe, 4 in. in diameter and 2 ft. long, made of sheet iron only about a fortieth of an inch in thickness, and found it stood, without buckling, a compressive stress 15.9 tons per square inch, whereas one of the Britannia Bridge rectanguler cells, 18 in. square and 8 ft. long, made of plates and angles half an inch thick, crippled under a stress of 13.6 tons, or say 15 per cent. less stress than that sustained by the piece of stove-pipe. If flat plates, as much as half an inch in thickness, behaved so badly in a rectangular cell only 18 in. square, it is hardly necessary to speculate as to what would be the case in tubes 12 ft. square, which would be the size required for the Forth girders. With rectangular struts formed of four corner pieces and lattice sides, the required strength of the latticework has been found by experiment to be considerably greater than theory would indicate, and the form, therefore, is a very disadvantageous one as compared with a circular cross section where every particle of metal performs useful work. In a long span bridge it is essential to reduce the secondary bracing to a minimum, because the weight of metal itself constitutes the chief load. For that and for many other reasons, including the comparatively small resistance offered by a curved surface to the wind, the author, after carrying out not a few experiments himself, and passing in review the numerous experiments made by others during the past thirty years, was satisfied that a circular form of cross section was the proper one in the case of the Forth Bridge. All the main compressive members, therefore, will be tubes varying in diameter from 5 ft. to 12 ft., and only the wind bracing, subject to alternate compressive and tensile stresses, will consist of rectangular latticed members.

Between the two main girders, as described above, the double line of railway will be carried on an internal viaduct, supported by trestles and cross girders. The permanent way will consist of heavy bridge rails on longitudinal sleepers bedded in four steel troughs, the outer pair of which serve also as the top members of the girders of the internal viaduct, and the inner pair being simply rail-bearers. The width of the trough is such that, in the event of derailment, the wheels will drop into the troughs, and run along the timber sleepers clear of obstruction. A buckle-plate floor and parapet or wind screen will be provided of ample strength to insure the safety of the trains. No guard rails will be introduced, as the engineers and the Board of Trade are in accord in considering them a source of danger during high winds.

It is hardly necessary to state that the whole of the superstructure will be of steel. For the tension members the steel is to have an ultimate tensile strength of not less than thirty tons nor more than thirty-three tons per square inch, with an elongation of 20 per cent. in a length of 8 in. For the compression members the strength is to be from thirty-four to thirty-seven tons, and the elongation 17 per cent. In making the tubes and other members, all plates and bars which can be bent cold are to be so treated, and, where heating is essential, no work is to be done upon the material after it has fallen to a blue heat. The steady pressure of hydraulic presses is to be substituted for hammering wherever practicable, and annealing will be required if the steel has been distressed in any way. No punching or shearing will be allowed, and all plates will be planed at the edges and butts, and all holes drilled through the whole thickness of plates and angles after being put together.

Previous to the preparation of the designs and estimates, many consultations were held with the Board of Trade officers with reference to the maximum wind pressure to be provided against, and the admissible stress upon the metal. Existing rules limit the stress to 6½ tons per square inch, and it was desired to get this limit extended to 7½ tons. This was assented to by the Board, as the 6½ tons working stress was based upon the assumption of the steel having a minimum ultimate tensile strength of 26 tons per square inch, whereas the Forth Bridge steel was to have a strength of at least 30 tons. As regards wind pressure, the present Board of Trade provision of 56 lbs. per square foot has been adhered to, and that pressure has been assumed to take effect upon a surface equivalent to double the plane surface of the bridge, a deduction of 50 per cent. being made in the instance of the cylindrical surfaces. Under the combined action of the wind pressure, estimated as above, and a rolling load of two tons per foot run, or 3,400 tons on each span, the maximum stress would in no case exceed 7½ tons per square inch, whilst upon the members of the wind bracing subject to alternate compressive and tensile stresses, it would not be greater than 5 tons per square inch. In ordinary working—that is to say with heavy coal trains and light winds—the maximum stresses would be about 6 tons in tension and 5 tons in compression, which were about the same as the Saltash Bridge of 460 ft. span would be subject to under the same circumstances, and that bridge is of iron. Even assuming that such a hurricane as 56 lbs. per square foot could ever take effect over so large a surface as that offered by the 1,700 ft. girders, it was quite clear that no train could be on the bridge at the time, for a pressure of 30 lbs. to 40 lbs. would certainly stop the progress of any train. Without the rolling load the maximum stresses during the hurricane would, however, be only about 4¾ tons in tension and 6 tons in compression. Indeed, if the Forth Bridge were made of iron instead of steel, it would be a relatively stronger structure than either the Britannia or Saltash bridges, so that the 50 per cent. extra strength due to the adoption of the steel may be regarded as an addition to the factor of safety, and not as a necessity of the unprecedented length of span.

Continental and American engineers at the present time almost universally take note of the vast difference in the destructive effect of a live load and a dead load; but the Board of Trade entirely ignore this fact, and adopt the same limiting stress in a main girder, where the greater portion of the load may be dead, as in a cross girder where it is practically all alive, and where vibration is set up by every passing wheel. It is generally admitted—and the practice and experience of mechanical engineers confirm the conclusion—that metal of any class may be subject to a working stress twice as great under a dead as under a purely live load. Some engineers make a compromise and take the ratio at one and a half times. If this be done, and a factor of safety of three be adopted in the instance of a purely dead load, the admissible working stresses for iron having an ultimate strength of 20 tons per square inch would be 6⅔ tons for a dead load, 5⅓ tons for half dead and half live, 5 tons for quarter dead and three-quarters live (which is about the proportion obtaining in railway girders of 100 ft. span), 4⅓ tons for all live load, and 2⅓ tons for members subject to alternate tension and compression of equal intensity. With steel having a strength of 30 tons, the corresponding stresses would be 50 per cent. greater—that is to say, they would range from 6½ tons for an all live load to 10 tons for an all dead load. If the stresses be limited as above, the results of experiment and of actual practice show that a structure may be subject to an indefinite number of repetitions of the stress without injury. But, in the case of hurricanes, the repetitions will necessarily be few and far between, and higher stresses are therefore admissible in the members of wind bracing than in the piston rod of a steam engine, though both are subject to alternate tensile and compressive stresses. When it is remembered that the dead weight between the piers of the 1,700 ft. span is upwards of 10,000 tons, whilst the live load due to a couple of heavy coal trains would be less than one-tenth of that amount, the relative lowness of the 7½ tons per square inch maximum stress in the Forth Bridge girders, under the combined action of an impossible load and an improbable hurricane, will be conceded by all.

So far as the author is aware—although it has been established beyond all dispute that repeated application of a tensile stress amounting to two-thirds of the ultimate strength of the material would in time cause fracture—it has never been proved that the same conclusion applies to metal in compression. In fact, some of the authors experiments lead him to think that a contrary result might obtain. For example, one of the consequences of heavy varying stresses and vibration is that the quality of the metal deteriorates, both iron and steel becoming more crystalline and less ductile. These conditions are rather favorable than otherwise to the resistance of a compression member. Thus the author tested some columns, 30 diameters in length, of high class ductile steel, and of inferior crystalline steel, both having, however, the same tensile strength. The inferior steel bore 40 per cent. more load than the high-class steel, and it appears not improbable that, if the quality of the latter had been deteriorated by vibration and heavy stresses, the ultimate resistance would have been increased as regards compressive stresses almost as much as it would be diminished in respect of tensile stresses. Similarly, in columns of the same proportion, the commonest class of pig iron would beat the finest brands of wrought iron.

Long struts were avoided at any expense by some engineers, but, the author thought, without good reason. The tubular struts in the Forth Bridge, if made of iron, would resist as high a compressive stress per square inch as the top flange of any existing girder, and the same remark would apply to steel. An interesting series of experiments was recently made in America with full-sized wrought-iron hollow columns, from 8 in. to 12 in. in diameter, and up to 28 ft. in length. The influence of the length of the column on its resistance was singularly small. For instance, the 8-in. column when 15 diameters in length failed with a stress of 16.3 tons per square inch; and as much as 42 diameters in length, with 15.6 tons. Now the model of the Britannia Bridge, 76 ft. in span, failed with 14.8 tons per square inch compression; Brunel's 66-ft. girder, having a 3 ft. wide cellular top member, failed with 12.6 tons; and some girders tested by the author with 15 tons per square inch as an average on the top flange.

Taking the mean results of a large number of experiments, the influence of length between the practical limits of 15 to 25 diameters would just be appreciable; but, if only a few experiments were compared, the deduction might be drawn that lengthening a column, or rounding its ends, increased rather than reduced its strength. Thus one steel tube 20 diameters in length, tested by the author, bore 22 tons per square inch, whilst a similar tube of half the length bore only 19.2 tons. Again, a round-ended column, 20 diameters in length, bore 19.3 tons per square inch, whilst a flat-ended one failed with 18 tons. No doubt greater regularity would obtain with full-sized than with model tubes, but still the practical fact remained that, within the limits occurring in the Forth Bridge, the compressive resistance of the tubular struts would be as high as that of the top flange of any plate or box girder that could be built, and that whatever stress was admissible in the girder would be admissible in the struts. This was a reassuring result to arrive at, because the practical experience had been chiefly with girders, and not with tubular struts.

(TO BE CONTINUED.)

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

THE QUESTION of water-works is being considered by Negaunee, Mich.

WATER FOR LOCOMOTIVES.—Long tanks, from which water can be taken by express trains without stop, are to be built by the Consolidated road between Bridgeport, Conn., and Fairfield, and at Rowayton.

ADDITIONAL WATER SUPPLY.—Northampton, Mass., has not yet settled its water problem. Engineer Davis estimates that it will cost $6,000, exclusive of land damage, to build another reservoir on Roberts' meadow brook, to increase the water supply, which would have a capacity of 12,000,000 gallons.

MINNEAPOLIS, Minn., is getting exercised over the questions of water supply and fire protection.

WASTE OF WATER.—At a meeting of the Boston Common Council held Sept. 28 the orders for an expenditure of $25,000 for the purchase and attachment of Deacon waste-water detectors, and for the appointment of not more than 20 inspectors of fittings, at a salary of not over $75 each per month, for a term not exceeding one year, came up by special assignment. A substitute was offered authorizing the Water Board to expend a sum not exceeding $70,000 for water-recording meters and putting the same in operation, providing that no meter shall be put on any house of a less value than $5,000; also authorizing the City Engineer to appoint 24 inspectors at a salary not exceeding $75 per month each. After some discussion the substitute was accepted and referred to the Committee on Finance, with instructions to report at the next meeting.

THE PINTSCH LIGHT.—The Providence Railroad is said to be so well satisfied with the Pintsch light on its steamboat train that there is talk of introducing it on all its trains. The invention, as at present perfected, consists of a tubular receiver placed under each car, with a capacity of 344 feet of gas, under compression of eight and one-half atmospheres, or 127 pounds to the square inch. From this tubes one-quarter of an inch in diameter run to the various burners.

NEWPORT'S WATER BOARD.—NEWPORT, R. I., Oct. 4.—George H. Norman was elected President, Mayor Franklin, Secretary, and C. B. Weaver, Treasurer and Superintendent of the Newport Board of Water-works this afternoon. The directors elected were William P. Sheffield, Lieut.-Gov. Fay, Mayor Franklin, T. M. Seabury, W. H. Sherman and Postmaster Coggeshall.

Messrs. J. A. Cloud & Co., of 18 Wall St., N. Y., have been awarded the contract for water-works for Lyons, Ohio Stand-pipe. Two million gallons daily capacity. Water to be taken from the Mahoning River.

THE WATER COMMISSIONERS of Rahway, N. J., have entered a protest against the city of Orange damming the Rahway River to supply Orange with water and diverting it from Rahway.

BENEFIT FROM ARTESIAN WELLS.—From being the dryest and one of the unhealthiest towns in Southwest Georgia, Albany has become perhaps the best watered town in the state, and while the country round about is as full of sickness as ever, it has had very little, indeed, of the customary sickliness. All this has been brought about simply by boring two artesian wells. Over 500 ft. of boring was done at an expense of less than $1,500, and a supply of absolutely pure and ice-cold water fully sufficient to more than supply the wants of the city of 3,500 people is the result. Albany's example is being followed by several towns, and with the facts before them there is no reason why scores of South Georgia towns which are now regarded as unhealthy on account of their water should not become as healthy as the average.—*Atlanta (Ga.) Constitution.*

WORK has been begun on the water-works for Asheville. The *Citizen* says there is an easily attainable supply for a population of 30,000.

ELECTRICITY.

NEW TELEGRAPH COMPANIES.—The following companies have filed articles at Albany, N. Y.: The Commercial Telegram Company; capital, $50,000. (The lines of the company are to run from New York to different cities in this and other states.) The Mexican Northern Telegraph and Telephone Company, of New York; capital, $200,000. Its line is to run from New York through the State of New Jersey, and thence in a southwesterly direction to the city of Laredo and other cities in Mexico.

SAVANNAH, GA., is partially lighted by electricity.

RAILROADS.

NEW ILLINOIS RAILROAD.—The Kaskaskia River, St. Elmo & Southern Railway Company filed articles of incorporation with Secretary of State on the 27th ult. The object is to construct a line of road from a point in Shelby County through the counties of Effingham, Fayette, Marion, Jefferson, Franklin, Williamson, Jackson, and Union to a point on the line of the Cairo and St. Louis railroad. Capital stock, $500,000. The incorporators are all residents of Effingham County.

THE OUSATONIC VALLEY Railroad Company is the name of a corporation organized to build a road from Shelton, Ct., to the New England road at Sandy Hook. The route has been surveyed, and work will probably commence in a short time.

CANADIAN PROJECT.—OTTAWA, Ont. Oct., 2.—A proposition has been made to A. Keefer, Secretary of the Ottawa, Morrisburg, Waddington and New York Railway and Bridge Company, on behalf of a syndicate composed of New York and English capitalists, having in view the acquiring of the charter of the company and the immediate construction of railways and bridges over the Ottawa and St. Lawrence Rivers. Mr. Keefer has been asked upon what terms the transfer will be made. Plans of the bridges and a profile of the whole line have been prepared and forwarded to New York and England, with a memorandum from Mr Keefer of the terms and conditions he requires. A meeting of the provisional Directors of the Ottawa and Waddington Company will be held in Ottawa on Oct. 11, soon after which a meeting will be held in London, England.

A DESPATCH FROM FREDERICK, Md., dated Sept. 30, says: Civil Engineer Gill, of the Pennsylvania Railroad, will commence a survey of the new road between Frederick and Middletown next week. The road is to be equipped and operated by the Pennsylvania road.

THE MICHIGAN, INDIANA AND ST. LOUIS.—At length the Michigan, Indiana, and St. Louis Railroad has been located through Bourbon, and the contract let for the construction of the same. Work will commence at Bourbon, Ind., within the next thirty days.

THE Western North Carolina road is going ahead. On the line between Asheville and Ducktown 700 hands are employed in its construction. Twenty-four miles of the road, running as far as Waynesville, are completed and in running order. The line from Asheville to Ducktown is about 80 miles in length.

CHICAGO & ATLANTIC.—Fifty miles of steel remain to be laid on the Chicago & Atlantic road. The gap will be closed within a month, after which time the Erie expects to run through trains from Chicago to New York over its new line.

TRACTIVE FORCE FOR MOVING VEHICLES.—Some experiments have been made at Salem, Mass., to ascertain the tractive force requisite to move street cars and vehicles on a macadamised road. The apparatus used consisted of an inclined plane, at the upper end of which was an iron wheel, over which passed a rope. A loaded box-car, weighing, with its contents, 12,820 pounds, was drawn up the grade by a weight of 970 pounds suspended at the other end of the rope. A smaller car, weighing when empty 2,730 pounds, was occupied by fourteen persons, and drawn up by 339 pounds, and when unoccupied by 176 pounds. An ordinary load of sand on a macadamised road was started by 314 pounds, and an empty hack, weighing 1,550 pounds, by 198 pounds; the same hack, with four passengers inside, required 280 pounds to move it. On a level road, the load of sand was started by 240 pounds, while the large box car yielded to 56 pounds.

A NEW RAILROAD ENTERPRISE.—WESTCHESTER, Pa., September 29.—Those having the preliminary arrangements in hand for the building of the Delaware River, Phœnixville & Lancaster Railroad met in Phœnixville on Thursday, and took the necessary steps toward placing its construction under contract at once. Theo. Bertolet, a Phœnixville engineer, has been given the charge of looking after the line in Northern Chester County, and will in a few days have men employed upon it in giving the required grade.

RAILWAY CAR-SEAT RIGHTS.—There was quite a discussion in a railway car last night as to the right of an official of the train to remove the valise and coat of an occupant of a seat—a gentleman in attendance on the board meetings—who was then temporarily absent. He contended he had that right, while a learned judge, who was in the same car, on being appealed to, decided that the first occupant was entitled to his seat. On a railway train in Canada last week the claim of an occupant to a seat, whose baggage had been removed by an official to accommodate another person, was sustained, and it was returned and he resumed his seat.—*From the Portland (Me.) Press, Oct. 4.*

NEW ZEALAND NOTES.—WELLINGTON, September 7.—The New Zealand Parliament has passed bills authorizing loans to the extent of £4,000,000 for railways and public works, and has approved a resolution in favor of direct communication between England and New Zealand, with a subsidy of £30,000. Native affairs are quiet, and all the late difficulties are apparently ended.

THE NEW PEMIGEWASSET VALLEY ROAD.—Rail-laying on the new Pemigewasset Valley Railroad has been temporarily postponed, having reached Mad River, in Campton, about five miles north of the starting-point, on account of no bridge being yet built across it. Grading, ballasting, &c., are still progressing.

NEW RAILROAD ROUTE.—The engineers have commenced laying out the established route of a new road from Delmar to Cherrystone, Va.

CANALS

THE NICARAGUA CANAL.—SAN FRANCISCO, Oct. 3.—The Oregon legislature has passed a joint resolution asking Congress to pass an act of incorporation of the Nicaragua Canal Company, which will be filed with the Secretary of State at Washington, for presentation to Congress next session.

CONTRACTS LET.

CHURCH CONTRACT LET.—The building committee of the Second Congregational Church of Holyoke, Mass., has awarded the contract for the new church to P. B. Johnson, of Palmer, for $50,800.

BRIDGE CONTRACT LET.—The Huntington *Commercial* says that the contract for building a bridge across the Ohio at Point Pleasant was given to the Keystone Bridge Company, of Pittsburgh, price $289,000. The bridge will be 1,400 feet in length, and must be completed in six months.

The bids for removing wreck and cargo of the government transport "Maple Leaf," from St. John's River, near Mandarin, Fla., were Samuel R. Cummings, N. Y., $14,250; J. A. Cloud & Co., New York, $4,800; R. S. Ross, of Fernandina, Fla., $5,800.

BUILDING.

CAMBRIDGE, Md., is to have a new $14,000 jail.

THE WISCONSIN CAPITOL.—The work upon the northern extension to the capitol at Madison is progressing with considerable more rapidity than that upon the south extension, the foundation for which is not yet entirely completed. The heavy iron joists for the first floor of the northern extension have all been placed in position, and the masons are now engaged upon the superstructure. The dressed stone-work is being pushed and the rough foundations are now nearly hidden by the wall which is outside of them.

MAKING FLOORS FIRE RESISTIVE.—Among the various plans now resorted to by English builders for rendering wooden flooring resistive to the action of fire is that of constructing solid timber floors, composed of ordinary joists placed close to each other, and spiked or screwed at intervals with bolts; the latter are fixed alternately, and, to form a key for the plastering, angular grooves are cut under each joist, these grooves forming a series of dove-tails. In a similiar manner, stairs are formed by a series of joists screwed or spiked together. With regard to partitions, preference is given by many to the French plan of constructing them with quarterings, filled in with rough stone rubble, then lathed on each side with strong laths, and a coat of plaster applied and pressed through the vacuities from each side. In the construction of roofs, the laying of solid concrete flats on iron joists, or iron joists fixed to the inclination of the roof, and then filled in with concrete on the French system, covered with asphalt, is a method highly approved.

LABOR.

LACK OF BRICKLAYERS IN CINCINNATI.—The demand for bricklayers in Cincinnati far exceeds the supply. This can probably be accounted for by the fact that all the buildings are being pushed in order that they may be got under roof before the winter sets in. The union price for bricklayers is $4.50 day, but some bosses are offering $5 per day. This will, no doubt, lead the men to strike for $5 all along the line on or before the first of next year, and thus business will receive another set-back. Cincinnati really needs about 100 more masons

MISCELLANOUS.

TWO NEW CANADIAN PROVINCES.—OTTAWA, Ont., Oct. 4.—It is understood that the creation of two new provinces in the northwest has been decided upon by the government. One will be Qu'Appelle, with Regina as its capital and Mr. Dewdney as its Lieutenant-Governor. The other will be Saskatchewan, the capital for which has not yet been decided upon.

BIDS FOR BUILDING A RESERVOIR.

The following bids were received at the Department of Public Works, this city, on Oct. 2, for building a reservoir at Rye Ponds, in the towns of Harrison and North Castle, Westchester County:

NAMES OF CONTRACTORS.	125 acres grubbing and clearing.	1,000 cu. yds. rock excavation.	30,000 cu. yds. earth excavation.	15,000 cu. yds. embankment and rip rap.	50 cu. yds. concrete and stone masonry.	1,200 cu. yds. stone masonry.	200 cu. yds. concrete masonry.	2,300 cu. yds dry stone wall.	45 m. ft. oak or chestnut plank and timber.	3,000 lin. ft. fence.	1,000 sq. yds. sodding.	1,700 lbs. wrought iron.	One 30 in. stop-cock and gearing.	90 lin. ft. 6-in. pipe.	175 lin. ft. 30-in. pipe.	TOTALS.
Sullivan & King	$25.00	$1.35	$0.32	$0.35	$18.00	$6.50	$5.00	$3.50	$40.00	$0.75	$0.30	$0.10	$150.00	$0.35	$1.25	$41,007.33
Dunn & Phelan	120.00	2.25	2.25	2.00	18.00	8.50	7.50	.06	100.00	1.10	.50	.20	500.00	total 200.00	total 1,000.00	140,028.00
John Satterlee	20.00	1.15	.24	.48	20.00	5.50	10.00	2.25	55.00	.45	.30	.05½	70.00	.55	1.50	[illegible]
L. P. Hendricks	3.50	.95	.28	.30	19.00	5.00	4.50	2.70	45.00	.70	.15	.08	175.00	.40	1.10	35,914.40
W. Phelan	15.00	1.25	.30	.30	22.00	5.50	5.00	2.00	7.50	1.50	.30	.05	100.00	.50	1.00	60,508.40

The proposal of L. P. Hendricks, being the lowest one received, was sent to the Department of Finance for examination and approval of sureties

THE FORTH BRIDGE.*

BY B. BAKER.

(Concluded from page 353.)

The author's experiments conclusively prove that steel is far superior to iron as a material for struts, though the superiority is not so great as when tension members are in question. Thus the Forth Bridge struts will be from 30 to 40 per cent. stronger in steel than in iron, while the tension members will be about 50 per cent. stronger. It does not follow that the steel strut would not be 50 per cent. better also as regards actual work, which is very different to what takes place in a testing machine. A steel or an iron rail, tested for transverse strength in a machine, will, as a rule, bend many inches, and fail by distortion of the head under the compressive stress. In actual work hundreds of such rails break, but it is the tensile and not the compressive stress which causes the failure, and there is no distortion of the head as in the testing machine. Similarly, when riveted girders break under traffic, it is not the top flanges with a calculated stress on the average of about one-third of the ultimate resistance that give way, but the bottom members, where the calculated stress is only about one-fourth of the ultimate resistance. In short, the universal experience is that fatigue is far more injurious to iron or steel under tensile than under compressive stress, and it follows that the factor of safety should not be the same in the two cases. This is quite consistent with ordinary practice, for probably the majority of girder bridges in this country have equal-sized top and bottom flanges, which, after allowing for the riveting, would give a factor of about 3 for the compression and about 4 for the tension members respectively.

The peculiarities of steel are tolerably well understood now, and amongst other precautions it is especially desirable to so design the joints in tension that no tearing action shall be set up along a line of rivet holes. Accidents of workmanship necessitate the provision of a good factor of safety in steel joints in tension; but, after watching the testing of many steel tubes under compression, the author cannot conceive any accident of workmanship which could bring about the failure of steel tubes such as those in the Forth Bridge, even if the working stress was raised to two-thirds, instead of about one-fourth of the ultimate resistance. In fine, he believes a steel tube to be the most trustworthy member which could be introduced into a great and unprecedented work.

As regards cost of manufacture, the difference is comparatively small between a circular and a rectangular member. The main tubes will be made up circumferentially of ten bent plates, lap-jointed and double riveted through the flanges of ten rolled beams, which will run longitudinally through the whole length of the tube. Stiffening rings will also be introduced at suitable intervals. The junctions of the tubular struts with the tubular bottom members offered some little difficulty at first in designing, but this being surmounted, the manufacture of the junction lengths becomes, as it were, a piece of ship-builder's work, except that the ship-builder has to deal with far more complex curvatures than will be found in the junction lengths.

Before dismissing the question of steel in compression, the author would wish to mention the results of some experiments made by him on steel which had been previously subjected to end pressure in a tube, so that flexure could not occur. The rods were 1 in. diameter by 30 in. long. With the mildest steel, the resistance to flexure was 14.5 tons per square inch in the uncompressed rods, and 22 tons, or say 50 per cent. more, in the rods which had previously been subjected to an end pressure of 36 tons per square inch. With somewhat harder steel, the corresponding figures were 16 tons in the uncompressed, and from 26 to 29 tons in the previously compressed bars—a gain of from 60 to 80 per cent. The bars, when tested in tension, showed no loss in strength or elongation from the previous compression. As 30-ton steel, after the end pressure had been applied, bore as much load without flexure as 54-ton steel which had not been so treated, it is clear that the adoption of mild steel in railway bridges would be much accelerated if some simple practical method could be devised for bringing about the molecular change effected in the above instances by an end pressure.

Is has been stated that the maximum wind pressure upon the 1,700-ft. span has been assumed to be equivalent to a pressure of 56 lbs. per square foot upon double the superficial area of the girder. It is to be regretted that this assumption necessarily involves many matters of pure conjecture. For example, though a wind pressure of 56 lbs. has undoubtedly been registered by anemometers, exposing a surface of a couple of square feet, it has never been proved to prevail instantaneously over so great a width as the 1,700 ft. span. Again, the relative resistance offered by the windward and leeward girders of a bridge have not been measured, and still less has any experimental approximation been obtained to the resistance of an entire bridge with its floor and cross bracing. Probably much may be done by models, and the author intends to so ascertain, if possible, the probable resistance of the Forth Bridge expressed in square feet of flat surface. Experiments with relation to wind pressure have been commenced at the site of the bridge—a pressure board, 20 ft. long and 15 ft. wide, having been fixed on the top of a tower on the island of Inchgarvie, where the central pier of the bridge will be placed. The apparatus is adapted to test the relative resistances offered by different surfaces, and during the progress of the works it is hoped many now open questions may be settled. The experiments will probably not affect in any way the design of the bridge, because the leading features of the design and the working stresses and wind pressure to be provided for have long since been settled with the Board of Trade. Until the experiments are complete, however, it will be impossible to state with precision what factor of safety will belong to the work, though it is possible to state, without reservation of any kind, that in any event the Forth Bridge, as designed, will be relatively stronger than any other bridge yet constructed. Owing to the large dead weight and the spread of the girders at the piers, a wind pressure, equivalent to 2 cwt. per square foot upon the surface of one girder, would be required to overturn the bridge, assuming it not to be held down by bolts. The holding-down bolts provided, however, about double the resistance to overturning, so 4 cwt. of wind pressure per square foot upon the single surface would be required to upset the bridge; and under this ideal pressure, though the wind bracing would, it is true, be on the point of failing, none of the great tubes or tension members of the main girders would even be permanently deformed.

Changes of temperature as well as gales of wind will affect the stresses upon the steel, but to a comparatively insignificant extent. In designing a certain class of work nothing embarrasses an engineer more than questions arising out of the expansion and contraction of materials. An experienced engineer will know that in certain instances he may entirely ignore the influence of temperature, while in others it is all important. For example, if a provision were not made in the case of point rods, the points would fail to close, and great loss of life might follow the consequent derailment of a train, while, on the other hand, infinite complication would result if a similar provision had to be made in a structure like the Crystal Palace, or in long station roofs, or in girders carrying buildings. Only experience could decide whether it would be safe to carry an ornamental ashlar-faced building on a girder 150 ft. in length without running the risk of inducing cracks in the masonry; but the author, having tried it, can say that the effects of temperature in such a case may be safely ignored. Similarly he had used, without inconvenience, girders 680 ft. in length in the floor of a building, and purlines of equal length in the roof a of station. Each case must, however, be dealt with on its own merits; for in another instance, where a gas works roof had fallen down like a pack of cards, he had traced the cause of the accident unmistakably to the expansion of the iron slate battens, which were exposed to exceptionally high temperatures at times. An engineer is apt to consider he has taken sufficient account of expansion if he adopts the conventional course of placing one end of his girders on rollers or sliding plates, so that the bridge may be free to expand in the direction of its length. The superstructure, it is true, may be twice as wide as it is long, but it must take its chance as regards expansion in the direction of the width. Arched station roofs, such as the St. Pancras roof of 240 ft. span and 700 ft. length, seem to require no provision for expansion in either direction. Again, the Victoria Bridge at Pimlico has longitudinal girders 913 ft. in length, and cross girders 100 ft. in length, with no provision for expansion in either direction. On the other hand, at the Southwark Bridge, grooves had to be cut in the masonry to admit of the free expansion of the cast-iron spandrils, which had been fractured by expansion in several instances, though the arch was only 240 ft. in span, and the spandrils were not continuous across the piers. However much the engineer may desire to eliminate stresses due to expansion, he will find it impossible to do so for the very obvious reason that the temperature is not uniform at any instant, and that even in this climate there may a difference of 50° between the temperature in the sun and in the shade. Take the case of an ordinary lattice girder with trough-shaped top and bottom members and double lattices. One side plate of the trough may be highly heated by the direct rays of the sun, and the other be completely in the cool shade, and one tie bar may similarly differ from its companion bar in temperature. If the girder were free to warp in any direction like a thin plank, little stress would result; but as it is not free to adapt itself to the unequal heating, stresses of considerable severity must occur, since 12° increase of temperature is the equivalent as regards elongation of one ton per square inch stress. On a hot sunny day the Britannia tube was found to warp 3 in. laterally and 2½ in. vertically when free to move; and, clearly, if such tendency be restrained, uniformity of stress is unattainable. The Forth Bridge tubular struts would similarly tend to curve under the action of the sun's rays, but, being braced together, they will not be free to do so, and stress must result. Every structure, in fact, is subject to such stresses, which are one of the things covered by the usual factor of safety. Stone buildings and arches are no exception to the rule; indeed, the author, from instances which have come under his own knowledge, is satisfied that the stresses due to changes of temperature are often relatively far more severe in stone than in iron arches.

Since by no practical means could stresses from expansion and contraction be wholly eliminated from the Forth Bridge, it became a matter for careful consideration what provision for expansion would be requisite or expedient, and what could be dispensed with. There could be no doubt, of course, that longitudinal expansion in the 1,700 ft. span should be provided for by placing one end of the 350 ft. girder on rollers where it was supported by the cantilever. The direct stresses would thus be eliminated, but there remained those due to the unequal heating of the different members, as in every other bridge. These stresses were not included in the estimated maximum tension and compression per square inch given in the previous part of this paper, but were assumed, as usual, to be covered by the factor of safety. A more difficult question arose with reference to the portions of the girders between the piers. Thus the Inchgarvie pier consists of four cylindrical masses of masonry, spaced 270 ft. apart longitudinally and 120 ft. apart transversely, centre to centre. The point to be decided was whether the great girders should be bolted to each mass of masonry, or be fixed at one end only of the above 270 ft., and be placed on rollers at the other end. This would be done, as a matter of course, with an ordinary 270 ft. span girder bridge but the conditions here were very different. In the first place, the pressure was enormous, and a bed-plate 35 ft. by 18 ft. was not a convenient one to provide with rollers. The most important point, however, was that sudden and unequally distributed gusts of wind caused stresses, which rendered it extremely desirable to dispense with rollers if possible. On considering the question in detail, it proved to be quite possible to do so. The range of temperature in this climate is not really great on well-protected surfaces, as the practical uniformity of temperature a few inches below the ground testifies. Taking the average of twenty years' observations at Greenwich, the mean shade temperature of the different months ranged from 38.94° in January to 62.54° in July. As the average for the whole twenty years was 49.69°, the range was thus merely 11° below and 13° above the mean temperature. Since 12° corresponds to a ton per square inch stress, iron-work bedded at a mean temperature in a mass of masonry might well be subject to no greater stress from variation of temperature than plus and minus 1 ton per square inch, which is far less than would obtain in a so-styled free-to-expand structure exposed to the rays of the sun.

Last year was characterized by great extremes of temperature. In January the temperature fell to 12.7°, while in July it rose to 97.1°, a range of no less than 84.4° in the shade. The lowest mean daily temperature was 19.4° in January, and the highest 78.6° in July—a range of 59.2°. The maximum daily range was 37°, and monthly range 58°, both in July. In the sun the temperature rose as high as 150°, so the extreme range for the year would be no less than 137°. The average yearly range being less than 34°, a clear explanation is thus afforded of the fact so well proved by experience, that provision for expansion is essential in point rods, signal wires and similarly exposed and light pieces of iron-work, while it may safely be ignored in the case of girders inclosed in buildings or bedded in jack arches.

Having reference to the considerations thus briefly set forth, and to the behavior of existing structures of all classes in this climate, it proved, on investigation, to be quite unnecessary, as far as temperature was concerned, to provide rollers at Inchgarvie pier. The steel tubes between the four cylindrical masses of masonry will be covered, like marine boilers, with a couple of inches of "fossil meal" or some other suitable non-conducting material, and an exterior iron envelope. Inside the tubes will be lined with about 2 ft. in thickness of cement concrete, to serve as an equalizer of temperature, and these precautions being taken, the results of calculations show that the stresses from changes of temperature will be of no moment either to the superstructure or to the masonry.

There still remained the question whether, for other reasons than temperature, rollers might not be necessary at Ichgarvie. Since the 270 ft. long tubes would be erected upon scaffolding, there would be no stress upon the metal at first, but as the erection of the cantilevers by overhanging proceeded, there would be the gradually increasing thrust from the bottom member, and it appeared difficult to say whether this thrust would come upon the tubes or upon the piers as abutments, unless rollers were introduced. A compressive stress of 5 tons per square inch would shorten the tube $1\frac{1}{2}$ in., and as the stout masonry piers would tilt very little, this movment could not occur, and the tubes would not take up their share of the work unless some sliding were provided for. After a careful consideration of all the conditions of the problem, including changes of temperature, the author came to the conclusion that a certain amount of initial stress on the tubes between the masonry piers was desirable, and although it might at first appear to be difficult to do this with a tube 12 ft. in diameter by 2 in. in thickness, the difficulty vanished, as usual, upon being grappled with. He proposed simply to make the upper and lower bed-plates, which were intended to slide on each other during the erection of the bridge, with serrated surfaces sloping at an angle of one in six. As the coefficient of the well-greased and planed steel surfaces would not exceed one-twentieth of the load, the shortening of the tube under the compressive stress due to the erection of the cantilevers would proceed freely, whilst the desired initial stress would be put on partly by the weight of the structure and the tightening of the holding-down bolts taking effect on the one in six incline, and partly by the test load of the bridge. A movement of $1\frac{1}{2}$ in. would be provided for temporarily, and the two bed-plates would finally be gripped together, and made fast to the piers by forty holding-down bolts of 3 in. diameter. When complete, the stresses on the metal would never exceed the limit of $7\frac{1}{2}$ tons under the joint influence of live load, wind, and temperature, and the pressure upon the masonry piers and foundations would be well within the working limits.

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* From a paper read before the British Association.

It is unnecessary to refer in detail to the mode or erection, as it is obvious that the work will be commenced at each pier, and be proceeded with by adding successive portions to the ends of the cantilevers until the same are complete. The central girders will also probably be erected on the overhanging system, temporary connections being formed between the ends of the cantilevers and the central girder. The closing lengths or key pieces at the centre of each 1,700 ft. span will be put in on a cloudy day, when there is little variation in temperature, and the details will be so arranged that the key piece can be completed and the temporary connections cut away in a few hours, so as to avoid any temporary inconvenience from expansion and contraction.

No special difficulty will arise with respect to the foundations, though the works will be, of course, on an unusually large scale. The island of Inchgarvie is of trap rock, and the central pier at that spot will consist of four cylindrical masses of concrete and rubble-work, faced with granite, and having a diameter of 45 ft. at the top and 70 ft. at the bottom. The height above high water will be 18 ft., and the depth below the same will vary from 24 ft. to 70 ft. After the sloping face of the rock foundation has been cut into steps, wrought-iron caissons will be floated out, lowered into place, and filled with concrete lowered through the water in hopper-bottomed skips. Queensferry Pier will be founded on boulder clay. Open-topped cylindrical caissons, 70 ft. in diameter, with an external and internal skin, 7 ft. 6 in. apart, will be floated out and lowered into place. The space between the skins will be filled with concrete, to give strength and weight to overcome frictional resistance in sinking. Grab excavators will be carried on a turn-table top to the caissons to remove the earth from the interior, and pneumatic apparatus will be supplied to enable men to clear boulders from the cutting edge of the caissons. From a depth of 6 ft. below water upwards, the masonry will be built in the dry, inside a movable caisson connected by an india-rubber joint with the permanent caisson below it. The piers will be carried down at least 10 ft. into the boulder clay, which will give depths ranging from 68 ft. to 88 ft below high water and 18 ft. less at low water in the respective cylinders. In round numbers the weight of one of the cylindrical piers at Queensferry may be taken at 16,000 tons, and the combined vertical pressure on the top of the pier from the dead weight of superstructure, rolling load, and wind pressure at 8,000 tons; so the load on the clay would average about six tons per square foot over the area of the foundation. This is an insignificant amount on such hard clay as that at the Forth, and the margin is ample, therefore, to allow of the unequal distribution of the pressure due to the action of partial blasts of wind and of a certain amount of expansion in the tubes connecting the piers.

The total length of the great continuous girder is 5,330 ft., or say a mile, and of the viaduct approaches 2,754 ft., or rather over half a mile. There is nothing calling for special remark in the viaduct. The piers will be of rubble masonry, faced with granite, and the superstructure of iron lattice girders with buckled plate floor and trough rail bearers, as in the instance of the main spans. The main girders, spaced 16 ft. apart, will be placed under the railway, and there will be a strong parapet and wind screen to protect the trains.

To engineers little need be said respecting the stiffness of a girder bridge having the proportions adopted in the present case. The central girder has a depth of one-seventh of the span, whilst the cantilevers may be looked upon as halves of a girder having a depth of one-fourth of the span. Exceptional depths like these confer exceptional stiffness, and there is the additional fact that the live load of a passing train will be quite insignificant as compared with the dead load of the structure. The heaviest train traversing the bridge will not deflect the 1,700 ft. girder more than 4 in., which is considerably less than the deflection of the 460 ft. span of Saltash Bridge under its test load, whilst a wind pressure, equivalent to 30 lbs. per square foot over the entire 1,700 ft., would bend the bridge laterally less than 9 in.

About 42,000 tons of steel will be used in the superstructure of the main spans, and 3,000 tons of wrought iron in that of the viaduct approach. The total quantity of masonry in the piers and foundations will be about 125,000 cubic yards, and the estimated cost of the entire work, upon the basis of the prices at which the original suspension bridge was contracted for, is about 1,500,000. Owing to the varying price of steel, and to the magnitude and novelty of the undertaking, this estimate must be taken as approximate only, as a contract has not yet been concluded for the works.

It will be gathered from the preceding necessarily brief and incomplete description of the proposed Forth Bridge that no novel or untried elements enter into the design. In principle, a continuous girder is as old a type of construction as an arch or a suspension bridge; and probably, in prehistoric times, streams were crossed by the aid of a couple of overhanging branches and an intermediate central portion constituting a structure rude in appearance, but identical in principle with the great bridge. The merit of the design if any, will be found, not in the novelty of the principles underlying it, but in the resolute application of well-tested mechanical laws and experimental results to the somewhat difficult problem offered by the construction of so large a bridge across so exposed an estuary as the Firth of Forth.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(Continued from page 341.)

CCLXXXV.—BRANTFORD.

Brantford, Ontario, Canada in lat. 43° 20 N., long. 80° 20′ W., is at the head of navigation on Grand River.

Settled about 1830, it was incorporated as a city in 1876. Water-works were built in 1870 by a private company, after plans of C. H. Wilson, taking the supply from a small creek about a mile from the town. The water is partially filtered through gravel, and is then pumped by a Worthington duplex engine, 100 ft. into a brick tank 15 by 26 ft., and 10 ft. deep. For fire protection, a high-pressure engine, built by Watrous & Co., pumps directly into the mains. Distribution is by $4\frac{1}{2}$ miles of cast-iron pipe, 8 to 4 in. diameter, with 50 fire hydrants and 60 taps. There are 8 meters in use. The city pays the company 8 per cent. per annum on their outlay for water for fire and public uses. Service pipes are reported as of cast iron. The population in 1880 was 10,500. The daily consumption in 1881 was 150,000 gallons.

The capital stock of the company is $50,000. The works have cost $48,000. There is no debt.

The expenses in 1881 were $2,310.11, and the receipts $9,127.35.

T. S. Shenston is the Secretary and Treasurer.

CCLXXXVI.—AUSTIN, NEV.

Austin, Nevada, in lat. 39° 30 N., long. 116° 35 W., is in a cañon of the Toyabee range of mountains, on the western slope.

Settled in 1863, it was incorporated as a city in 1864. Water-works were built by a private company in 1865, taking the supply from tunnels tapping a vein of water in the mountains. The water is collected in a brick reservoir holding 50,000 gallons at 500 ft. above the city, and is distributed through about 1 mile of riveted galvanized iron pipe and gas pipe of from 6 in. to $\frac{1}{2}$-in. diameter, with 8 gates and 250 taps. Wrought-iron pipe is used for services. The city has a separate supply for fire purposes.

The population in 1880 was 2,150. The daily consumption in 1881 was 30,000 gallons.

The works have cost $20,000. No further financial statements are given.

H. H. Allen is Secretary and William Foster the agent of the company at Austin.

CCLXXXVII.—MIDDLETOWN, N. Y.

Middletown, New York, in lat. 41° 25′ N., long. 74° 18′ W., is on Monhegan Creek, in a hilly region.

Settled about 1755, it was incorporated as a village in 1848.

Water-works were built by the village in 1867, taking the supply from springs and surface drainage from a water-shed of 8 square miles. An earth dam 25 ft. high, across a narrow valley, floods an area of 60 acres, forming a reservoir holding 300,000,000 gallons, 150 ft. above the town.

In 1875 there was a deficiency in the supply, and a pump of 12-in. bore and 20-in. stroke, driven by water-power, was erected by the Holly Manufacturing Company, taking a supply from the Shawangunk Kill (the old Dutch name for a creek), $8\frac{1}{2}$ miles from and about the same level as the reservoir, to which the water is conveyed through a 12-in. wooden pipe made in 15 ft. lengths of white pine staves, $2\frac{3}{4}$-in. thick, banded with strap-iron and coated on the outside with coal tar. After the pipe was laid it was found that the town had no right to use the creek water, and six years of litigation followed before the new works could be used, resulting in the payment of $1,400 for the right to use surplus water flowing over the dam on the stream when the mills were supplied. The pipe follows the surface, descending at one place 75 ft. below the reservoir and at another rising 25 ft. above it. When tested, after lying unused for six years, only three lengths of it burst.

Distribution is by 6 miles of pipe of from 12 to 4-in. diameter, with 40 fire hydrants. The number of taps is not given. There are 6 meters in use. The first pipes laid were of wrought-iron and cement. Some of this has been replaced by cast-iron, which is alone used in extensions.

The population in 1880 was 9,500. The daily consumption is not known.

The works have cost $170,000. The bonded debt is $160,000, at 6 per cent. interest.

The expenses for the year ending May 1, 1882, were:

For maintenance	$1,500.08
For extensions and land and water damages	5,087.10
For interest	11,371.50

The receipts were $10,637.13.

The works are managed by 5 commissioners.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks: From Wm. Foster, agent, statistics of the water works of Austin, Nevada. From T. S. Shenston, Secretary and Treasurer, statistics of the water-works of Brantford, Canada.

THE NECESSITY, USE, AND CARE OF WATER-METERS.

The rapid increase in population in this country, from natural causes and by immigration, is giving rise to grave fears that the water supply, particularly in the larger cities, will soon be insufficient to meet the growing demand for that necessary adjunct to life and health. Practical men are seriously considering the question, whether to enlarge the sources of supply or to curtail the enormous waste of water which is constantly taking place in all parts of the land. In some cases the former method will be found absolutely necessary in a few years, to say the least. In the city of New York, for instance, the rapid increase of population has already placed the adequacy of its present water supply in doubt, and the authorities are preparing to increase that supply from other sources. But in the great majority of cases a method of stopping the waste everywhere prevalent will be found the most effectual as well as the most economical plan to provide for the requirement of many years to come. To the question, How to stop that waste? I answer, that its practical solution, in my humble opinion, may be found in the use of the water-meter with its system of registration, similar to that by which gas is measured. The facts that many systems of water-works have recently been put in operation throughout the states; that many more are in process of construction, and that others are being contemplated, serve as constant admonitions to the public of the necessity of an economical use of one of "God's best gifts to man." Under a rate based upon a system of registration the consumer is required to pay for all the water which passes through his meter. The more used the greater the expense. A due regard for domestic economy or for the profits of business would be a further incentive to retrenchment in its use by the patron. In this it would be to him a question of dollars and cents; and the purse-pocket is a tender place to the majority of mankind. The general adoption and use of the water-meters cannot be too strongly urged. Soon it will be found of absolute necessity in all cities where water-works exist. Of great practical benefit, its use will also be found to be a handsome source of income to any corporation by which adopted. Having had several years' experience in the construction of water-meters, and having closely observed the uses to which they are put, permit me to offer a few suggestions as to the care which should be bestowed upon them after being set and ready for operation. This is an important point, though simple, and a knowledge of it will often save the time and expense of disconnecting, examining in shop, and resetting a meter. When a meter has been set and the water allowed to enter it many people suppose that then the work is complete. But the meter does not operate satisfactorily. Perhaps it is not properly adjusted; perhaps it is owing to certain conditions of the water, which may contain grit—lime—or it may be too high a pressure. Don't hammer the meter, you may perhaps bruise it; and if so, will doubtless displace its inside works. No one would think of striking a clock or sewing machine if out of order. Yet the same gentle treatment bestowed upon these useful articles, when in need of repair, should be given the water-machine if we would reach the end for which it is employed. A careful examination may reveal the presence of paint or red lead inside, which may have been used in the connections in making the joints tight. Whatever the obstruction have it removed, as in a number of instances such might easily be done, and the meter properly re-connected. Nor should a meter be set for service where it could be injured by freezing in cold weather. Some one of these points has frequently caused water-meters to be condemned and returned to the maker as useless. A large percentage which have came under the observation of the writer for repairs were condemned for some one of the above-mentioned reasons, and were easily and speedily set to rights.

The invention and adoption of a water-meter that will cover all the technical points raised by some writers on the subject, in our opinion, we are not warranted in waiting for, and will probably not soon be brought out; at least not in our day. With the universal adoption and proper care shown to the meters now generally manufactured we have enough to fill unlimited requirements for many years to come.

Chas. H. Page.

Worcester, Mass., Oct. 2, 1882.

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THE IRON MARKET.

[From the Iron Age.]

New York, Oct. 11, 1882.

American Pig.—The market rules quiet, its chief business being deliveries on old contracts, which go on without interruption, and are said to be sufficient to absorb, if not the entire production, the product of those brands most in favor here. There is very little Iron offering, and no pressure to sell that we can hear of. The tone of the market is strong and values firm as follows: Foundry No. 1 X, $26@$27; Foundry No. 2 X, $24@$24.50; Gray Forge, $22.

Scotch Pig.—The supply of Scotch Iron in this market is unusually light, and most of the afloat lots are said to be engaged. The demand is fair, and but for the high prices prevailing a larger business would be done. Sales reported during the week aggregate over 500 tons various brands. We quote: Eglinton, $23.50@$24; Carnbroe and Glengarnock, $25.50@$26; Coltness, $28, Gartsherrie, $26, and Langloan, $26.50@$27.

Rails.—Sales are reported by Pennsylvania mills of 13,000 tons of Steel Rails for delivery in 1883 at $45, and 1,000 tons near-by delivery at $46 at mill. We quote $45@$46 for Steel. Iron Rails continue to be neglected and prices nominal.

Old Rails.—The business transpiring in Old Rails is very light, and there is scarcely any inquiry. Holders' views are about $27.50@$28 for Tees, and $30@$31 for Double Heads.

Philadelphia, Oct. 10, 1882.

Plate and Tank Iron.—There has been very little done during the past week, so that quotations are more or less nominal. Tank Iron and Common Plates generally could be had at about 3c., but there is no disposition to buy, except small lots, for which extra rates are obtained. The outlook at the moment is decidedly weak and unpromising, but a few good-sized orders would soon restore confidence. In the meantime, quotations are as follows: Tank Iron, 3c.@3.25c.; Shell Iron, 3.8c.@4c.; Flange, 5c., and Fire-box, 6c.

Structural Iron.—There has been very little demand lately, and, although the leading concerns have a good deal of work on hand, they are gradually catching up, and would be glad to see new business coming in, but, with the exception of an order for about 2,000 tons for bridge work, there is no special inquiry at the moment. There is no particular change in prices, but desirable orders would doubtless be accepted at slight concessions from quoted rates, which are 3c. for Angles, 3.8c.@4c. for Tees, and 4c. for Beams.

Wrought Iron Pipe.—The demand during the week has been active and quotations, although unchanged, are inclined to be easier; quotations are about as follows: Gas and Steam Pipes, 57½ per cent., and Boiler Tubes, 45@47½ per cent. off list price.

Railway Fastenings.—Spikes are in good demand and firm at about 3c.@3.1c.; Fish Plates, 2.6c.@2.75c.; Bolts and Nuts, 3.75c.@4.25c.

Pittsburgh, Pa., Oct. 10, 1882.

Manufactured Iron.—Manufacturers generally report business as being fair, and while but few, if any of them, are pressed with orders, they are all in good spirits in expectation of a fairly active and healthy business during the remainder of the year. Large jobbers and consumers as well are disposed to hold back until the market becomes more settled. We continue to quote card prices: Merchant Bars, $2.50 rates; No. 24 Sheet, $4.30; Tank, $3.80; Skelp Iron, $2.75@$2.85.

Nails.—There is no abatement in the demand, and makers are assured of a good trade until the close of the year. The outloook for a good Nail trade has not been so encouraging for many years. Prices remain unchanged at $3.40 rates, 60 days, 2 per cent. off for cash, with usual abatement of 10c. per keg on car-load lots and upward.

Wrought-Iron Pipe.—The mills are now all in operation, and as yet have accumulated no stock; as is always the case, small sizes are most in demand, and manufacturers are unable to catch up with their orders for these. Prices remain unchanged: Boiler Tubes, 45@47½ per cent. off. Oil-well Casing, 70c. per foot, net; ditto Tubing, 20c. The improvement in oil is likely to cause an increased demand for all kinds of oil-well supplies.

Railway Track Supplies.—Railway Spikes remain unchanged at 3c., 30 days. Splice Bars are quoted at 2¾c.; and Track Bolts at 3¾c. with square, and 3.90c.@4c. with hexagon nuts. There is an increasing demand for all kinds of railway supplies.

Chicago, Oct. 9, 1882.

Manufactured Iron.—Merchant Iron has been in very good demand during the week past; back orders are being filled as rapidly as possible, and altogether a better feeling exists among dealers and consumers than heretofore. We note a change in quotations, Bar Iron being now quoted at 2.70c.@2.80c.; Angle, 4c.; T, 4½c.; Beams and Channels, 4½c.@4¾c.; Hoop at 4c.; Sheet, Plate and Tank, 10 to 14 gauge, 4c.; 15 to 17 ditto, 4.30c.; 18 to 21 ditto, 4.60c.; 22 to 24 ditto, 4.80c.; 25 to 26 ditto, 5c., and 27 ditto, 5.20c. Patent Cold-rolled Shafting, dis. 20 per cent.; Norway Iron, Original Bars, 5c. rates; Norway Iron, re-rolled, 6c. rates; Ulster Iron, 4½c. rates; Low Moor Iron, 8c. rates; Nuts and Washers, 7½c. off list; Wrought Boat Spikes, 3¾c. rates.

◆

RECENT INVENTIONS PATENTED DURING THE PRESENT WEEK.

INSULATING UNDERGROUND ELECTRIC WIRES.

This improved method of insulating underground telegraph wires consists in placing a row of wires longitudinally in a receptacle. The wires are then covered with silicate of soda in a fluid state, and permitting it to harden. Another row of wires is then arranged on the hardened insulating silicate material, and treated in the same manner. The silicate of soda is in direct contact with the wires.

ARCHED GIRDER.

The arch-sections of this girder are so formed, having transverse cylindrical end extensions and corresponding recesses, as to cause the endwise compression thereof, resulting from the tensile strain on the tie rod, on which they rest through vertical supporting braces, to act in the line of the intrados of the arch.

EXCAVATING MACHINE.

In this invention the lower end of an inclined trough and the inner end of the plow rest in a stirrup suspended by arms to a frame, moving in vertical guides on the frame of the machine, and operated by toothed segments engaging cogs thereon, the shaft of the segments having a lever and pawl engaging a rack. An endless elevating chain, carrying hoes, which move through the trough, consists of sections having a plate to which each hoe is secured. The lower end of the chain passes around a sprocket-wheel, having its shaft bearings in spring followers in a slotted frame, and having its free end resting on lugs on the adjustable plow frame. The shaft bearings of the upper sprocket-wheel of the chain are formed on the sides of the dirt box. The chain is driven by gearing with teeth on the operating wheels. The upper end of the trough rests on a bent plate hinged to the framing. The bottom of the dirt-box consists of drop doors hinged to plates on the sides of the box, and operated by bell cranks, open links and rods connecting with levers at the driver's seat.

TRUSS BRIDGE.

This truss is built up of light material, interlaced and arranged to take the strains, and spiked or bolted. Vertical end posts, a series of horizontal girders, diagonal braces and vertical tie-rods are combined together. In other words, the posts or uprights are composed of separated strips, and the series of horizontal chords are also composed of separated strips fitting between the strips of the post and secured thereon. The diagonal lattice braces are secured to and through the horizontal chords, extending the whole distance from the bottom to the top chords.

APPARATUS FOR DREDGING HARBORS.

This improvement comprises a water-ballasted boat, a changeable water-ballast to obviate effect of rise and fall of tide, a vertical pump-tube provided with spiral propellers in swells of the tube, said propellers being open in their axial region, a rotary foot-tube and digging-bit hinged to the pump-tube by a hollow knuckle-joint, a turn-table carrying the tubes, and mechanism to cause a slow forward and rapid back movement for automatically rotating the turn-table and to cause the foot-tube to work on a horizontal plane.

Washington, D. C. F. B. Brock.

◆

MORE PHILADELPHIA ENGINEERING.

The discussion in the Councils on the subject of street pavements does not indicate that familiarity that should be possessed by those who undertake to decide what kind of pavement is best adapted to particular streets and roads. Both the proposed asphalte pavement on North Broad street and the Telford drive on Twenty-second street were objected to on the ground that the city should avoid "patent" pavements. The ignorance herein displayed is appalling. If, instead of proposing to macadamize a road, we should speak of a Macadam pavement, Councilmen would probably take alarm. The fact is that the Telford is simply the improvement on the Macadam roadway that is in common use on many of the best drives in and around the city. The Macadam is a surface composed wholly of broken stone, while the Telford consists of layers of broken stone on a sub-pavement of stone blocks. It makes an excellent drive, but it requires continual sprinkling to keep down the dust and a system of minute daily repairs to prevent its wearing into ruts. It is not adapted to city traffic, but for the Park drives it is the right thing, and perhaps, also, for the needed drive to the Park.

As for asphalte, a real asphalte pavement, such as may be seen in Paris and London, is never to be confounded with the patented imitations—abominations of coal-tar and the like—of which we have had so many sad experiences. These things are not to be considered for any important thoroughfares, but every engineer knows that a good asphalte pavement on a concrete foundation combines more of the essential qualities of a good pavement than anything else, including even granite blocks, except for the hard pound of central thoroughfares in town. For such use as would be required on North Broad street the asphalte pavement is far better than the Belgian. It costs less and is nearly as durable, unless the stone blocks be unusually well chosen and unusually well laid. It is more easily cleaned than any other pavement, has no interstices to harbor filth, and makes altogether the smoothest, quietest, cleanest and pleasantest driveway that can be laid. This refers, of course, to thoroughly good work, and nothing else is worth having.

It is one of the queer things about the government of Philadelphia that although there is a Chief Engineer he has nothing to do with the building of roads, and the Chief of the Highway Department does not profess to be an engineer or even a road-builder. This very important subject, requiring large professional knowledge and experienced supervision, is thus left to amateurs or to the chance decisions of a committee of Councilmen who may or may not know anything of the subject. The result is that the contractors generally determine what kind of pavements shall be laid, and then lay them in such a way that they are probably the worst in the world.—*The Times, 11th.*

◆

North Sea Canal.

One of the most remarkable of the great canal projects now occupying the attention of engineers is that of uniting the North Sea with the Mediterranean. Like most other enterprises of this character, it is old in conception, dating back, it is claimed, to the beginning of the Christian era. Four years ago it took a definite shape in a plan for a canal from Marseilles to Lyons and then to Dunkirk. During the present year a substitute was suggested in the form of a canal from Bordeaux to Narbonne. This latter plan, though possessing great advantages in point of distance, the route being much shorter and less expensive than the other, yet, on the other hand, is less attractive as an enterprise of vast scope, since it would merely connect the Bay of Biscay with the Mediterranean, cutting off the doubling of the Spanish peninsula. Whichever project is selected, it would be remarkable to find the earth's surface so cut up that a ship may pass from Bombay to St. Petersburg solely through inland waters, as it would be able to do by using the Suez, the French and the Danish canals, the three being designed for the largest commercial vessels

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.

S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, OCTOBER 14, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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THE NEW ENGLAND WATER-WORKS ASSOCIATION is in session at Salem, Mass., this week. The preliminary meeting was held April 9, 1882, in Boston. The first annual meeting was held at the same place June 21, when a Constitution and By-laws were adopted, and officers elected. The President is James W. Lyon, of Salem, Mass.; Secretary, R. C. P. Coggeshall, of New Bedford, Mass. There are 27 active members now enrolled. With four exceptions, they are Massachusetts water-works superintendents. The Association is so conservative and modest that it has heretofore carefully abstained from sending us any notice of meetings or report of proceedings. No doubt these meetings are productive of much valuable information to water-works managers and superintendents.

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TO WATER-WORKS OFFICIALS.

"The History and Statistics of American Water-Works," which has been appearing in our columns since March, 1881, now comprises statistics of 387 towns. There are about 200 more towns which have water-works. To the officers of every one of these works at least three appeals have been made for information, and to some of them four requests have been sent, but they neglect to answer. If any persons who can give information regarding the water-works in the following towns of over 10,000 population, which are all the places of that size from which replies have not been received, will send a postal card to us stating their willingness to furnish the necessary data, a blank form will be sent showing what kind of information is wanted:

Biddeford, Me
Brockton, Mass.
Burlington, Vt.
Camden, N. J.
Canton, Ohio.
Chattanooga, Tenn.
Cohoes, N. Y.
Columbus, S. C.
Dallas, Texas
Davenport, Ia.
Dover, N. H.
Easton, Pa.
Evansville, Ind.
Galveston, Tex.
Haverhill, Mass.
Hyde Park, Ill.
Joliet, Ill.
LaCrosse, Wis.
Lewiston, Me.
Little Rock, Ark.
Long Island City, N. Y.
Los Angeles, Cal.
Mobile, Ala.
Muskegon, Mich.
Portland, Oregon.
Pottsville, Pa
Rock Island, Ill
Rutland, Vt.
Sacramento, Cal.
Saginaw, Mich.
San Antonio, Tex.
San José, Cal.
Shenandoah, Pa.
Springfield, Ill.
Stamford, Conn.
Stockton, Cal.
Steubenville, Ohio.
St. Joseph, Mo.
Wheeling, W. Va.
Youngstown, Ohio.

We hope water-works officials, and others who may possess the desired information, will assist us in completing this very valuable and interesting compilation. Already its value is being appreciated and it is consulted, so far as published, by parties in search of water-works data. The instances of this from Des Moines and Albany, which we publish elsewhere this week, are but two of many such that are occurring all the time. We have had numerous inquiries for the completed book, and also many expressions of satisfaction from water-works people concerning it. If an effort were only made, we could soon push it to completion, and thus put at the disposal of interested parties a treatise to which there will be no equal for convenience of reference in any other specialty in public works construction. We again urge the possessors of the desired information to put forth an extra effort in our behalf, and their own.

◆

IMPROVEMENT OF POTOMAC RIVER.

The last Congress made an appropriation of $400,000 for improving the Potomac River in the vicinity of Washington. This referred to the improvement of navigation, the establishment of harbor lines and the reclamation of the flats. The plan proposed by Major P. C. Hains has been accepted, and in accordance with it the work will be carried forward. It is estimated that the cost of the improvement will be about $2,500,000.

The improvement of navigation will be accomplished by dredging a channel from Easby's Point, near Georgetown, to near Giesboro' Point, below the Arsenal, and from there to Long Bridge, in the Washington channel. This will be of a depth sufficient to float any vessel that can reach Giesboro' Point; 20 ft. will enable vessels drawing 22 ft. to reach Georgetown and Washington. Closing the Washington channel at the foot of Fourteenth street and raising the flats will contract the river and make it necessary to provide such a width to the Georgetown channel as will carry the discharge. According to the plans, the least sectional area at low tide should be not less than 25,000 sq. ft.; high water section, 32,875 sq. ft., and freshet section not less than 48,000 sq. ft. The excavation required is as follows:

	Cubic yards.
In Georgetown Channel....................	6,250,570
In Washington "	1,732,792
From south end of Long Bridge....................	300,000
Total....................	8,283,362

Additional material for filling the flats can be obtained from the shoal near the proposed bulkhead wall on the upper side of Long Bridge, and from other places.

The proposed harbor lines are described as follows:

The bulkhead will commence near Easby's Wharf and extend in curved line to a point at or near the southerly end of the causeway of the Long Bridge, thence continuing to a point at the intersection of the Washington and Georgetown channels, below the wharf of the United States Arsenal, thence returning along the westerly side of the Washington channel in front of the city wharves and about 800 feet distant from them to Long Bridge. The bulkhead line adjacent to the city, from Fourteenth street to Greenleaf's Point, is of irregular form and follows along the inner end of the wharves from Fourteenth street to the Arsenal.

The raising of the flats will be accomplished by depositing on them the material obtained from the channels, and from other sources. The areas to be reclaimed are as follows: About Long Bridge, 420 acres, of which 127 acres will be occupied by lakes: area below the bridge, 330 acres; total, 750 acres. The total amount of material required to raise the flats to the proposed grade will be about 12,000,000 cubic yards. Of this amount 8,283,362 cubic yards will be obtained from the channels and from the south end of Long Bridge; 1,824,090 cubic yards by dredging from the lakes, and the remainder, about 1,892,548 cubic yards, from other sources.

The estimated cost of the work is as follows:

10,107,452 cubic yards of material taken from dredged channels and lakes, at 18 cents........	$1,819,341
892,548 cubic yards from other sources, at 18 cents....................	340,658
Revetment wall of reclaimed area....................	173,555
Revetment wall of lakes....................	66,000
Outlet and inlet sluice gates, as estimated by the late Major Twining....................	70,000
Contingencies....................	246,955
Total....................	$2,716,509

Further on it is explained that the price of "18 cents per cubic yard for dredging and depositing the material is considered low. It is hardly to be expected that the work can be done at a lower figure unless a contract could be made for at least one half of the entire work at one time."

Of the $400,000 appropriated, $300,000 will be expended in dredging a channel from deep water near Giesboro' Point to Georgetown, 20 ft. deep and as wide as it can be made for that sum—it is estimated that it can be made 400 ft. wide. The material excavated will measure about 1,700,000 cubic yards. (Proposals for this work will be received by Major P. C. Hains, Engineer Corps, U. S. A., until Oct. 30. For advertisement we refer to page X. this issue.) The sum of $70,000 will be applied to the construction of the inlet and outlet sluiceways for filling the lake referred to and purifying the water in the Washington channel. The remaining $30,000 to be allotted to office expenses, contingencies, etc.

The specifications state that the channel will be about 20 ft. deep at low water, and 400 ft. wide. The length to be dredged above Long Bridge will be about 7,500 ft., and below the bridge about 4,000 ft. The depth of cutting will be from 1 to 12 ft. The material to be excavated has been found to be sand and mud. The excavated material will be deposited on the Potomac Flats within the bulkhead lines to be established by the engineer. The amount of material to be dredged above the bridge is 1,100,000, and below the bridge, 600,000. The work must be completed by August 31, 1883.

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SIXTH ANNUAL REPORT OF THE BOSTON WATER BOARD, 1881-82.

From the report of the Boston Water Board for the year 1881 we have gleaned the following:

Daily average consumption, 38,214,900 gallons, equivalent to 92 gallons per head of population.

Total revenue from use of water, $1,328,171.28.

Total number of meters in use (including water motors), 1,727.

Daily average consumption through meters, 601,730 gallons.

Number of families supplied, 78,916.

Length of supply and distributing mains, 489.3 miles.

Total cost of construction of works, $18,577,972.69.

The works are stated to be, with few exceptions, in good condition. The great increase in the consumption during the past few years has had the effect of taxing the capacity of the works to their utmost. At the present time a storage reservoir, having a capacity of 1,100,000,000 gallons, is being constructed on Stony Brook, a branch of the Sudbury River, and the report contains a recommendation that work upon still another reservoir should be at once begun.

The question of the prevention of waste is considered at some length, and a detailed account is given (illustrated by diagrams) of experiments made with the Deacon waste-water meter in the Charlestown district. The further application of this system of waste prevention is recommended.

PERSONAL.

MR. C. A. **HAMMOND** has been appointed superintendent of the Boston, Revere Beach & Lynn railroad, in place of Mr. **EDWARD H. WHARF**, resigned. Mr. L. C. **LEGRO**, late master of transportation, has resigned.

MR. **HAMMOND**, engineer and general manager of an important Brazilian railroad, bears strong testimony to the value of coffee as a preventive against miasmatic fevers. He instances the case of Father Vaughan, who, on a journey through a most unhealthy country from Panama to the River Platte, considered that he owed his health to taking strong coffee, and mentions that since the natives in pestilent districts in Ecuador have taken to drinking it the death rate has fallen considerably.

GENERAL WILLIAM SOOY SMITH & SON, civil engineers and contractors, have opened offices in the new Montauk block in Chicago. They have just closed an important contract for the substructure of a bridge across the Yazoo River for the Memphis, Vicksburg & New Orleans road. The foundations are considered very difficult, owing to the nature of the soil and of the river. The water is ordinarily 30 ft. deep, but at certain seasons rises to a total depth of 80 ft.

UNLESS M. DE LESSEP's son VICTOR has misrepresented him, the cleaver of the continents, who is revising the plan of creation in the matter of isthmuses and seas, recently cut a caper in Egypt which must have staggered even the melodramatic appetites of a French audience. "My august father," says M. VICTOR DE LESSEPS, describing a scene which he says occurred at the time of the seizure of the canal by Sir GARNET WOLSELY, "my august father was not wanting to the occasion. He had round his neck a paper collar of English make. He did not hesitate for a moment, but tore it off and danced on it. This was his response to the insolence of the invader." The picture is interesting and suggestive. What a field for heroism it opens to our own SPINOLA! If by this saltatory sacrifice of his shirt-collar M. DE LESSEPS merely meant to express his contempt for perfidious Albion in the abstract, it would be harsh to pronounce it ridiculous. An insult to a flag is an insult, whether it is offered to the ensign of a man-of-war or of a mud-scow. And who can tell whether, in the present Jingoist condition not only of the British mind in general but of the mind of GLADSTONE in particular, an insult to a British paper collar, there being no other emblem of the hated island available, might serve at least to foment a diplomatic correspondence? On the other hand, if M. DE LESSEPS' wrath was kindled against his paper collar as a paper collar of British make, it is clear that, if in his wrath he remembers logic, he should have treated with similar ignominy all other articles of his wearing apparel which had been produced by English cloth-workers or English tailors. The spectacle of M. DE LESSEPS rending his inner garments in a paroxysm of wrath, like King Lear, and repelling the insolence of an invader by dancing on his own shirt-collar, though possibly to be commended as strictly and severely logical, could scarcely have failed even in Paris to provoke Homeric laughter. Hereafter, therefore, the action of dancing upon one's shirt-collar will be classed in the same category with the mediæval custom of biting the thumb, or the more modern practice—to quote from Irwin's lament for Donnybrook—of

> "Trailing the coat in courageous defiance
> And shouting the pilaloo! over the green."

—*N. Y. World.*

WATER-WORKS FOR IRVINGTON, N. Y.

Irvington-on-the-Hudson has long felt the need of a pure and abundant supply of water for domestic and fire purposes. The village is situated on the eastern bank of the river, and now obtains its supply from wells and cisterns. The drainage of the vaults and cesspools on the elevated portions of the hill foul the waters below, and, as a consequence, the lower residents find it impossible to obtain a good supply. Some time since plans were prepared for a system of water-works to cost $75,000, but the scheme was defeated by the people at the polls, as the estimate was deemed too high.

Now, the President and Trustees of the village have organized as a Board of Water Commissioners, and have appointed W. A. Burnham, president; William Walker, treasurer, and Adam Busch, secretary. Plans and specifications were prepared by the firm of R. D. Wood & Co., of Philadelphia, who guarantee that the entire expense, including the land, will not be more than $25,000.

A short distance back of the village is a ravine through which flows a stream; by building a dam across the lower extremity of this a reservoir would be obtained of between 3,500.000 and 4,000,000 gallons capacity. The supply during the dry seasons has been estimated to be about 30,000 gallons daily, which, with the reserve provided by the reservoir, would be ample for some years to come. Should any addition be required by an increase of population or otherwise, it could be built at any time and at a proportionate cost as though built at the present time. The average head of water on Broadway (a street running parallel with the river and a short distance up the hill) will be about 100 feet, efficient for fire purposes at any point and insuring an ample flow through all the branches.

To-day—the 14th—the tax-payers vote on the proposition, and, judging from conversations we have had with several of the citizens, it seems that the plan will be sanctioned.

PROPOSALS.

Should the vote be favorable proposals for furnishing the materials and doing the work will be received until next Saturday, the 21st inst. In view of these facts we herewith publish the specifications in full; any further information can be obtained from the officers of the commission above named:

SPECIFICATIONS.

The work to be done is the construction of a stone and earth dam across the brook and side embankment with the necessary racks and screens and filter chambers; also the grubbing and cleaning of the space to be occupied by the reservoir and embankment; also the furnishing and laying of a supply main and the village system of distribution, the setting of valves and hydrants, all as shown on the accompanying plans and map, and the following description of the work to be done.

The entire space to be covered by water, or the embankment, shall have all perishable matter removed therefrom.

The reservoir to be built is formed by the construction of an earth and stone dam at the lower end, and low side embankment.

The main embankment shall be constructed as shown upon the plans. The dam proper shall be of rubble masonry, with a cut-stone coping over the entire top.

The cut-off wall shall be of rubble masonry. All interstices in the dam and cut-off wall shall be filled full of spalls and cement, so as to insure as water-tight work as can be made in that manner. All the joints on the outer and inner face of the dam shall be cleaned out to a depth of two inches and pointed flush with the face of the work with a cement mortar, composed of one part cement and one part of sand.

The side embankments will be formed from earth taken from the reservoir ground, and will follow generally the flow line as indicated, and of the dimensions shown on the plan.

The inner or water side of the main earth embankment shall be made of the finer portions of the excavated materials, and shall be put on in horizontal layers one foot thick and well wet, and rammed or rolled before the next layer is placed; the outer bank shall be composed of the coarser portions from the excavations.

All dimensions of this dam and embankments, and all work connected with it, shall be as shown on the accompanying drawings, copies of which will be furnished to the contractor.

The cement mortar used in the masonry shall be composed of one part of best quality of Rosendale or equally good cement; and two parts of clean, sharp sand.

The screen and gate chamber in the dam shall be constructed as shown on the plan, with a screen frame of pine, fastened to the wall in front of the affluent pipe, in which a fine copper screen fastened to an iron frame and sliding in grooves so as to be easily taken out for cleaning. The gates shall have the valve stems lengthened, so as to be operated with a short wrench from the top of the dam.

The filter gallery will be constructed of dry rubble masonry, also the masonry at the end of the mud and inlet pipe.

The inlet pipe will have a wrought-iron rack over its upper end.

The filter bed will be composed of round or broken stone, 18 in. deep, varying in size from 2 to 6 in. in diameter. Over the stone will be a layer of screened gravel, 15 in. in depth, varying in size from ¼ to 1 in. in diameter. Over the gravel will be a layer of clean sand 18 in. in depth.

At the upper end of the reservoir will be constructed an oak rack, as shown, resting against a dry rubble masonry abutment, and held in place with heavy iron bolts.

Along the back side of both side embankments will be excavated ditches 5 ft. wide and to a depth level with the spill-way of the dam.

The creek, for a distance of 500 ft. above the reservoir, shall be excavated to a uniform width of 12 ft. and to a depth of 1 ft. below the level of the spill-way of the dam.

The screen chamber will be covered with a double pine flooring, and matched and cross-boarded, and arranged with trap-doors convenient for raising the screen and operating the gates. The doors shall have wrought-iron hinges and lock and hasps.

The position of the mud-pipe, the distribution pipe, the valves, the amount of slope wall, dry wall, stone-filling, sand and gravel-filling, cut-off wall and dam masonry, screens and rack, shall be as shown, and built under and to the satisfaction of the engineer in charge, in the employ of the Board of Water Commissioners.

The pipe shall not be less than 12 ft. long, exclusive of hub, truly cylindrical, of the full internal diameter, and the inner and outer surfaces concentric and straight in the axis of the cylinder. All plain pipe shall be cast vertically in dry sand moulds, and of such quality of iron as to produce strong and tough castings that may be satisfactorily cut and drilled, and the iron in the pipe shall have a tensile strength of at least 16,000 lbs. to the square inch.

All pipe and specials shall be sound and smooth, without blister, cold shuts, or other imperfections, and the iron shall be free from admixture of cinder, scoria, or sand.

All castings shall be thoroughly cleaned without the use of acids, or other liquids, and uniformly coated with suitable coalpitch and oil.

And all pipes shall be tested at the foundry to a hydrostatic pressure of 300 lbs. to the square inch, and should the Water Commissioners so require, a sworn statement that the pipe has been so tested shall be furnished by the superintendent of the foundry to them.

All castings must have their weight distinctly marked on each piece with white paint.

The system of piping will consist of 144 lineal ft. of 12-in. pipe, 4,310 ft. of 8-in. pipe, 2,608 ft. of 6-in. pipe, 7,678 ft. of 4-in. pipe; three 12-in., two 8-in., three 6-in., three 4-in. valves, with box and covers; 17 double hose 4-in. stand-pipe hydrants, 6 lawn hydrants, most durable pattern.

SPECIAL CASTINGS.

1—12 inch, ⅛ bend.
1—12 " 8 reducer.
1— 8 " ⅛ bend.
1— 8 " 8 branch.
3— 8 " 8 "
1— 8 inch, 6 reducer.
1— 8 " 4 "
1— 8 " 8 branch.
1— 6 " 6 branch.
1— 6—4 reducer.
7— 4 " 4 branches.
1— 6 inch plug.
2— 4 " "
2— 8 " sleeves.
3— 6 " "
4— 4 " "

All pipes shall be laid 4 ft. below the surface of the road or street to the top of the pipe.

All the hydrants shall be set on the terrace between the curbing and sidewalk, and at points shown on the plan.

All pipes shall be laid, all hydrants and valves set, and branches placed where shown by the map, or may be directed by the engineer in charge.

All valves shall have a square wooden box made of 1½ in. frame and about 6 in. inside, reaching from the top of the valve case to the surface of the street and capped with a suitable iron cover, with the initials W. W. in raised letters cast on the upper side.

All hydrants shall have a movable frost jacket.

All hydrants and valves shall be of a kind and make approved by the Board of Water Commissioners.

The lawn hydrants shall be located where shown by the map, and connected with the main or hydrant branch with a ⅝-in. heavy lead pipe.

All hydrants shall have a drip cock so arranged as to remain open when the valve is closed.

The contractor shall furnish the village, free of charge, two valve wrenches, and two hydrant and hose coupling wrenches.

All joints shall be made with a good quality of jute, well compacted, and soft lead firmly upset. The 12 and 8-in. pipe shall have in depth of lead 1¾ inches, and the 6 and 4-in. pipe, 1½ inches in depth.

The material excavated from the trenches shall be returned to them in such order that that taken from the surface may be returned to the same place, and all back filling shall be well rammed, and the streets restored to as good condition as before as nearly as practicable.

All surplus material must be removed from the streets at the contractor's expense. No large stones will be allowed to be put in with the back filling within one foot over the pipe.

In blasting rock in the trenches due caution must be exercised in loading blasts so as to avoid damaging property. In case any person or property is in any way injured by blasting, the contractor shall be liable, and pay all such damages so incurred.

WEIGHT OF PIPE.

Each length of pipe shall weigh as follows:

	12 inch diameter.	12 feet long		805 lbs.
Class A.	8 " "	12 " "		476 "
" B.	8 " "	12 " "		524 "
" B.	6 " "	12 " "		372 "
" C.	6 " "	12 " "		380 "
	4 " "	12 " "		228 "

No allowance will be made for any excess above weights, and no pipe will be accepted or allowed laid that is more than 5 per cent. under the above standard. Weights prescribed for their respective locations as follows:

	144 feet	12 inch	at the dam.
Class A.	2,000 "	8 "	from the dam, west on Mountain road.
Class B.	1,900 "	8 "	on Mountain road.
" B.	1,110 "	8 "	" Broadway
" B.	450 "	6 "	" "
" B.	625 "	6 "	" Main street from B'way, west.
" C.	1,500 "	6 "	" " " below Aqueduct.
	3,170 "	4 "	" Broadway from 450 feet N. of Main street, south.
	4,300 "	4 "	" Broadway from Mountain road, south.
	204 "	4 "	" hydrant branches.

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CEDAR PAVEMENTS IN TORONTO.

The Committee on Roads in the Toronto Council have just awarded about $100,000 worth of contracts for cedar block paving of King street, from Don to Strachan avenue. From the abstract of tenders before us we note a great uniformity of prices throughout the whole distance. From the prices we judge that A. W. Godson was awarded the contract. His prices are as follows: Pavement per square yard, $1.15 to $1.19; stone curbing per lineal foot, 26c.; stone curbing, 80c. to 90c.; crossing plates per 100 lbs., $2.50; moving track per 100 lineal ft., $20. The names of parties tendering were: A. J. McBean, A. W. Godson, Geo. Farquhar & Co., Ardagh & Leonard, Trimble & Co., Richard West, R. Dinnis. Godson & West have also completed, this season, a system of sewerage for Parkdale, a suburb of Toronto, the total being about 7½ miles, at a cost of $60,000.

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GOVERNMENT CONTRACTS LET.

The following is a synopsis of certain government works in charge of Colonel G. L. Gillespie, Corps of Engineers, U. S. A., with the proposals recently received for furnishing the materials and doing the work.

Proposals for improving the Shrewsbury River, N. J.; dredging in the main stream and the two branches, and for the construction of 500 ft. of light dike; appropriation $30,000.

LIST OF BIDS.

Names.	Dredging. Price per cu. yd.	Diking per lin. ft.
Elijah Brainard	.35¼	$5.50
H. DuBois & Sons	no bid	5.00
Frank Pidgeon, Jr.	48 3-10	4.00

Awarded to Elijah Brainard.

Proposals for dredging in Flushing Bay, N. Y.; appropriation. $6,000.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley & A. J. Beardsley	$0.10¾
Frank Pidgeon, Jr.	.20

Awarded to H. N. & A. J. Beardsley.

Proposals for dredging channel from Canarsie Landing to Jamaica Bay, N. Y.; appropriation, $7,200.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley & A. J. Beardsley	$0.50 at sea, .40 in bay.
John McDermott	$0.67
Elijah Brainard	.48

Awarded to Elijah Brainard.

Proposals for dredging in Woodbridge Creek, N. J.; appropriation, $5,000.

LIST OF BIDS.

Names.	Price per cu. yd.
John McDermott	$0.74
John M. Weldon	.73
John H. Fenner	.65
E. Brainard and T. H. Benton,	.65
C. Somers	.75

Awarded to Messrs. Brainard & Benton.

Proposals for dredging in Newton Creek, east of Vernon Avenue Bridge, N. Y.; appropriation, $15,000.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley, A. J. Beardsley,	$0.27
J. W. Ambrose, D. Ambrose and R. J. Mills,	.29
C. H. Loomis	.40

Awarded to H. N. & A. J. Beardsley.

Proposals for improving Cheesequakes Creek, N. Y., by the construction of rubble jetties and timber dikes and by dredging; amount available, $35,000.

LIST OF BIDS.

Names.	Price for dredging per cu. yd.	Price for stone in jetties per cu. yd.	Price for timber platform foundation per sq. yd	Price for sheet pile revetment per lin. ft.
J. M. Weldon	.40	$4.50	$2.60	$8 double. $6 single.
H. Du Bois & Sons	.30	1.85	1.90	*
S. R. Cummings	.25½	2.50	2.30	$4.41
Frank Pidgeon, Jr	.53	1.50	1.80	5.65
E. Brainard T. H. Benton	.60	1.75	1.40	6.87
F. C. Somers	.43¾	....	....	....

* $6.07 for 200 ft., $7.17 for 2,000 with anchor piles.

Awarded to S. R. Cumming.

Proposals for improving Sumpawams Inlet, Long Island, N. Y., dredging channel from Babylon Landing to Great South Bay; amount available, $6,200.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley A. J. Beardsley	$1.40 if towed away. $1.25 if dumped in bay.
J. McDermott	.69
E. Brainard	.84

Awarded to J. McDermott.

Proposals for improving Sheepshead Bay, N. Y., for dredging a cut to connect east end of Sheepshead Bay with Dead Horse Inlet; amount available, $9,000.

LIST OF BIDS

Names.	Price per cu. yd.
H. N. Beardsley, A. J. Beardsley,	$0.45
J. McDermott	.67
F. Pidgeon, Jr.	.53
E. Brainard	.73

Awarded to H. N. & A. J. Beardsley

Proposals for the construction of the south jetty at the entrance to Manasquan Harbor, N. J.; amount available, $7,000.

LIST OF BIDS.

Names.	Price of timber jetty per lineal ft.	Price of stone in jetty per cu. yd.
S. A. Kelly	$11.00 for outer 200 ft 9.00 " following 100 ft. 8.00 " inner 200 ft.	$2.50
H. DuBois & Sons	13.50	5.00

Awarded to S. A. Kelly.

Proposals for dredging 140,000 cubic yards, more or less, from the channel between Staten Island and New Jersey; appropriation, $40,000.

Names.	Price per cu. yd.
C. H. Loomis	$0.24
E. Brainard, T. H. Benton,	.34
Morris & Cummings Dredging Co	.23¾
J. W. Ambrose, D. Ambrose, R. J. Mills,	.40

Awarded to Morris & Cummings Dredging Co.

Proposals for dredging 200,000 cubic yards, approximately, from the mouth of the Passaic River, extending up stream toward Newark, N. J.; appropriation, $48,000.

LIST OF BIDS.

Names.	Prices per cu. yd.
E. Brainard, T. H. Benton,	$0.35
Morris & Cummings Dredging Co	.23¾
J. H. Fenner	.29
E. M. Payn	.24 9-10
J. McDermott	.41
J. W. Ambrose, D. Ambrose, R. J. Mills	.55

Awarded to Morris & Cummings Dredging Co.

Proposals for dredging Mattawan Creek, New Jersey; appropriation, $6,000.

LIST OF BIDS.

Names.	Prices per cu. yd.
F. Pidgeon, Jr.*	$0.59
F. C. Somers	.68
E. Brainard, T. H. Benton,	.71
J. McDermott	.69

Awarded to F. Pidgeon, Jr.

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EXPERT OPINION OF BOOKS.

DETROIT, September 25, 1882.

To the Editors of the American Architect:

SIRS: Please state the best work on Strains in Structures, Heating and Ventilation; also the best work on Graphic Statics. Yours, etc.,

STUDENT.

[Rankine's "Applied Mechanics," Moseley's "Mechanics of Engineering and Architecture," or Peclet, "Traité de la Chaleur," Box on "Heat," Baldwin's "Practical Treatise on Steam Heating," and the articles in Buck's "Cyclopædia of Hygiene." Greene's "Graphical Analyses," Parts I., II. and III.—*Eds. American Architect.*]

CORRESPONDENCE.

VALUE OF COAL DUST AS FUEL.

KANSAS CITY, MO., Oct. 8, 1882

EDITOR ENGINEERING NEWS:

DEAR SIR: I would like to hear through the columns of your paper something about the progress being made in the burning of fine coal dust. I learn from what ought to be good authority, that claims are made that one ton of finely comminuted coal dust, fed into a furnace by air blast, is found to do the work of from two to three tons of raw coal burned in the usual manner. If any such facts exist, it seems singular that it receives so little attention from the scientific press. As this would tend to lengthen the apparently short lease of life given to the steam engine by the promoters of gas and electric substitutes, it seems to me that a few paragraphs from parties having actual knowledge on this subject would be of value.

Yours truly, G. W. PEARSONS.

AMERICAN ENGINEERS IN MEXICO.

HACIENDA DE SANTA BARBARA,
Sept. 18, 1882.
Estado de Jalisco.

EDITOR ENGINEERING NEWS:

Since my arrival in Mexico, nearly one year ago, I have missed your weekly greeting in ENGINEERING NEWS very much. I would suggest, in the interest of the large number of engineers now employed in Mexico, that the weekly issue be retained for your Mexican subscribers, subject to order on return to the States. I, for one, should regret very much being unable to complete my file of your paper, which contains in each issue so much valuable information for engineers in every department of the profession, and I know by sad experience that papers mailed to Mexico rarely reach their destination. I am now in charge of the work at the extreme point of the road, as resident engineer, with headquarters as above. I have a house, built of adobe or mud, one story high, as office, etc., with three rooms and kitchen. My amusement in the morning, before breakfast, is to hunt allacrans, and I usually succeed in finding two or three victims. The sting of the allacran, at this altitude (6,200 ft. above sea level) is not dangerous but is extremely disagreeable in its effects, being much more painful than a wasp or hornet's bite in the States. Living here in the country would disgust many of your readers. It is difficult to get any meat fit to eat, and yet every day we see abundance of quail, wild duck, snipe, etc., which the natives leave unmolested. Jack rabbits, as we term them on account of their resemblance to a jackass, are very numerous, and are immense compared with our American rabbit, being fully three times the size of the latter. The success of the Mexican Central seems assured. The rolling-stock now on hand is inadequate to handle the unexpectedly large demand made upon the freight department, and the receipts so far exceed the most sanguine predictions of the projectors of the road. The Mexican government and the people have a most friendly feeling towards the enterprise, and a rich return awaits the capitalists who invested in the enterprise while its success was problematical. I have examined with much interest the hydraulic works of the country, used for irrigation, and many of your readers versed in that department of engineering would be surprised to see the method of construction adopted for dams in Mexico, which have stood the test of service for years. The "presa," or reservoir dams, are almost universally built of two walls of masonry, filled between with earth, and the cross-section used would cause an American engineer to tremble for the safety of the structure. The theory adopted by the contractors, of course, is that the earth filling, being puddled, and of suitable material, will secure the *tightness* of the dam, the masonry serving only as walls to retain the earth and pressure of water. I intend, as leisure permits, to procure accurate measurements of some of the large fresh dams in the vicinity, and shall take pleasure in laying them before your readers for theoretical discussion. My address for the present is—Lagos, Estado de Jalisco, Mexico, and if you have a stray item of news I should be pleased to hear from you. We generally expect to receive about one paper out of six mailed, and then the news is about a month old. Sincerely yours,

C. H. M. BLAKE.

LITERATURE.

DRINKER'S TUNNELING.

The new edition of this standard work, which has been so eagerly looked for, has at last made its appearance. The delay has been due to the anxiety of its author to have the latest data on explosives and rock drills in the work, and many new cuts have been required, which it has taken much time to make. We congratulate both author and publishers on its appearance. The work is better printed and the paper seems to be an improvement, while the binding is stronger. The additions have been principally made in Chapters III., IV., V., VI. and VII., treating of explosives and drills. The latest of the various modern destructive agents will be found elaborately described, and all the new drills and compressors. More than 200 pages have been added in these chapters; also, several folding plates on tunnels appear at the back, and descriptions are in the text. Among them we notice several East Indian tunnels, and the celebrated Hudson River Tunnel. This being a book by an American engineer of celebrity, will undoubtedly take precedence over the much inferior works of Simms and André, notwithstanding the difference in price. The poorest economy for an engineer is to buy a CHEAP book. It may cost him not only reputation, but many thousands of dollars. We shall have copies for our subscribers and general customers, to whom we heartily commend it.

BALTIMORE.

Baltimore deserves to be known also as the City of Hills. Steep grades and sudden descents are the rule, a level street is the exception. The horse cars have a hard time of it, and have to station extra horses at every few corners to help tug the loaded cars up some steep grade. Many of the lines run only bob-tail cars, without a conductor, and find even these abundant work for two horses. A line of Herdics was once attempted, but given up in despair. Those vehicles might work well on the broad, smooth, and level avenues of Washington, but they were not suited for the cobble-stone pavements and numerous hills of Baltimore. Another result of the inequality of surface is the surface system of drainage. There are but few sewers in the city, and those are laid along the valleys to carry off water which would otherwise flood them in every storm. Nothing perhaps strikes the visitor more oddly and unpleasantly than to see in every gutter a constant stream of waste water, and find every few yards a little channel in the sidewalk, along which trickles the drainage from the neighboring house. It seems to him that, with such primitive neglect of a proper sewer system, the city must be a cesspool of disease. And yet its health average is high, particularly when we remember the difficulty of checking small-pox and such contagious diseases among the negroes. One secret of this is the abundant water supply. The former supply was sufficient for the city at present, but looking toward the future she has just completed a new system of reservoirs and aqueducts, which furnish her with a larger supply than the Croton can possibly give New York. Water is the cheapest of all necessities, and is profusely used. Each morning the gutters are flushed, the sidewalks washed off, and the city treated to a most healthy scrubbing. Again, every rain floods the streets and prevents the accumulation of filth in them. A smart shower will quickly gather volume enough from the hillsides to transform the lower avenues into brawling brooks and necessitate the use of the high stepping stones which are planted along the crossings in the older streets. Such a shower will do more toward cleaning the city than "Plunger" Walton and his carts could accomplish in a week.—*Correspondence Boston Journal.*

THE HENDERSON BRIDGE.

The following account of the work on this bridge has been furnished to the Henderson (Ky.) *Reporter*:

The bridge is being built by the Henderson Bridge Company, to connect the Louisville & Nashville Railroad south of the Ohio River with its St. Louis division and the other railways centering at Evansville. Its foundation will involve difficulties greater than those of any bridge west of the Alleghenies, excepting the bridge at St. Louis. There will be 16 spans with an iron viaduct approach on the Kentucky side, making a total length of 3,686 feet. The channel span will be 525 feet, the longest trussed span in the world. Of the 16 piers, at least six will be sunk by the pneumatic process to solid rock, which is about 42 feet below low water, and 54 feet below present water level. The grade of the bridge will be 53 feet above high water, or about 100 feet above lowest stage of the river.

The caisson just launched is about 54 feet long, 22 feet wide, and 13 feet high. Four courses of timber will be added at once, making the total height 17 feet when ready for sinking. This caisson, when completed, will contain 153,000 feet, board measure, of white oak, and about 28 tons of iron in form of shoe-tie rods, screw-bolts and drifts. The total weight of material in the caisson will be about 450 tons.

The caissons for channel span, work on one of which is well advanced, will be about one-third larger than the caisson just launched.

The high water in late spring and early summer encroached upon the limited space in which the caissons could be built, and prevented that rapid prosecution of the work which had been expected. The river has remained high, and the ways for launching had to be placed for 60 feet of their length in water ranging from nothing to 16 feet in depth. Every care was necessary, and much time was spent in securing this portion of the ways. There were 25 piles under the caisson; these with others beyond them supported four lines of ways, having a slope of about one inch to a foot at starting; this increased corresponding to a vertical curve of 550 feet radius until in depth of 12 feet of water; the average inclination was 3¼ inches to a foot. The caisson was built level and kept on carriages made to fit the ways; these carriages were connected in pairs, and excepting the bearing surface were built of poplar timber so as to insure their floating out as soon as they were free from the caisson. The carriages were tied back by lines which were strained by screws and jacks; when all the blocking had been removed these ropes were cut, liberating the caisson; the huge mass started slowly and smoothly, its velocity increasing until checked by the water; sufficient impetus had been gained, however, to push it into water deep enough to float it.

When the timber courses have been added, the temporary bottom, put in to confine the air space and insure floating, will be pushed out under the bottom edge, and, masonry being added on top, the caisson will be forced to the bottom of the river, and into it as rapidly as the laborers can excavate under the cutting edge. A pressure will be maintained at all times sufficient to keep water out of the chamber in which the work of excavation is conducted. The caisson passes through about 15 feet of gravel and 15 feet of soapstone shale, reaching the sandstone bed-rock. The air chamber is then filled with concrete, and the mass, solid, immovable and imperishable, forms the foundation of the tall pier which is to carry its portion of the steel bridge and railway traffic, 140 feet above its base.

The work on the bridge is now well started, and will be pushed forward as rapidly as practicable. The pier and abutments will require about 23,000 cubic yards of masonry. Large quantities of stone have already been delivered, and three quarries are now actively working to furnish limestone for the work: one at Baker's station, near Nashville; one at Russelville, and one at West Fork, near Pembroke station. Fine qualities of limestone are obtained from these points. Timber is now being delivered for two more caissons, which will be built this fall. The chief engineer of the Henderson Bridge Company is Mr. F. W. Vaughan, of Louisville; Mr. O. F. Nichols is resident engineer in charge of work at Henderson.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.—Alderman King, as Chairman of the Committee on Water-Works, presented on the 5th the following report on the troubles existing between the city of Des Moines, Ia., and the Water Company:

To the Hon. Mayor and Members of the City Council:

GENTLEMEN: The special committee, to whom was referred the resolution declaring the charter of the Water-Works Company forfeited on account of the failure of said company to comply with the conditions, requirements and terms of said contract, have the honor to report that we have had several joint meetings with a committee of the aforesaid company, with a view to a settlement of the trouble existing between the city and the company, and regret to say that we feel confident that there is no reasonable probability of said company ever consenting to such a just and equitable adjustment of the differences referred to as in the judgment of your committee would be a fair and reasonable compensation for the service rendered by said company in extinguishing fires and other requirements demanded by said charter. We deeply deplore the obstinacy of the company to agree to a reasonable modification of its rents consistent with the character of the service rendered. But aside from the question of extortion, the people of this city have just cause for alarm on account of the serious risk to which they are exposed by the negligence and fault of said water company to afford sufficient protection against fire. The facts developed in this controversy clearly prove the following propositions, viz.:

First, That the company are absolutely unable to comply with the essential requirements of its contract, and have been unable to so comply for the last eighteen months, if ever.

Second, The unsafe, unprotected and dangerous risk to which the city is at this time subject, appeals to this Council for some adequate relief or some suitable provision looking to that protection which a tax levy for fire protection has a right to receive.

Third, From all the evidence before your committee, gleaned from exhaustive statistics published in ENGINEERING NEWS, in which the question of water supply is elaborately treated on—as to cost, pressure, capacity of works, rate per hydrant and nearly all other matters having a bearing upon the question of water supply, hence your committee have deliberately concluded that in the event that the City Council shall agree to a new contract with said company, a fair and sufficient compensation for furnishing a sufficient supply of pure filtered water for the use of the citizens of this city and for protection against fire,—

Recommend that the following shall be a basis of settlement for a new contract, to wit: The company to be prepared at all times to furnish a sufficient supply of pure filtered water for public and private use and good fire protection. This to be an invariable requirement, not to be violated for any cause whatsoever, and for this service the city shall pay to said company the annual rent of $75 for each hydrant, not exceeding two hundred in number; $40 for the next hundred hydrants, and $30 per hydrant for the next three hundred hydrants, making the whole number provided for six hundred, at the different prices above named; the water company to furnish and set all hydrants hereafter ordered put down by the City Council, and to purchase the hydrants now in use.

All matters of detail which may be necessary to carry out a new contract between the city and water company to be submitted to the consideration of the Council for ratification before the same shall have any binding force upon this city.

M. H. KING.
S. A. ROBERTSON.
LEWIS HYLAND.
GEORGE GARVER.

The report was adopted without debate.—*Des Moines Register, 6th.*

WATER WORKS.—ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL, New York, is publishing a very interesting series of articles on the History and Statistics of American Water-Works, by J. James R. Croes, M. Am. Soc. C. E. In the number for Sept. 30, the Annapolis, Md., water-works are explained. The supply is obtained from a number of springs and small streams, collected in a well and thence pumped into a reservoir. The banks of this reservoir are puddled with clay and paved with granite. A brick trough is constructed three feet under the bottom of the reservoir and covered with wooden slats, one-half inch apart, on which coarse gravel is laid, with layers of finer on top, and a foot of sand over all. Through this the water filters, and is then conducted four miles to the city through a ten-inch main of cast-iron. Thus the city of Annapolis is supplied, in the first place, with pure spring and active live water, which is also filtered. The water for this city, we believe, is not subjected to filtration; but it should be. Letting it settle in the reservoir, we think, is not enough. If it were possible to draw the water off from the reservoirs and put filtering bottoms in them, that should be done as soon as possible.—*Albany, N. Y., Daily Press and Knickerbocker, 9th.*

MESSRS. THACHER & BREYMANN, the well-known submarine contractors, of Toledo, O., have been engaged since Aug. 1 in laying two lines of water-pipe across Cumberland River, at Nashville, Tenn. They expect to return to Toledo next week. This firm finds a steady demand for their services in the submarine work of water-works construction.

THE SOUTH ABINGTON WATER SUPPLY.—The committee chosen in town meeting July 22 to take into consideration the question of a water supply and fire department for this town, have submitted a written report. It contains three plans. One, the building of seven large reservoirs, to be filled by a steam fire engine from adjacent ponds, and the purchase of a fire engine, the necessary accoutrements and three Harkness extinguishers, at a total expense of $13,240.

The second plan is to lay about three miles of pipe through the principal streets, with 30 hydrants, connecting with the pump in the factory of Dunbar, Hobart & Whidden. By this means, the pump being put in operation, sufficient force would be obtained to throw water over any building within 1,000 feet of the hydrants. The expense attending this plan, including three Harkness extinguishers, is estimated at $16,890.

The third plan is to locate a reservoir 50 ft. in diameter and 60 ft. high on Tilson Hill, near the town,

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and to lay about seven miles of pipe to carry the water through the town, furnishing it for a fire department, for family use, etc. Estimates of cost, including two Harkness extinguishers, $40,000. This plan the committee, by the advice of Mr. Geo. H. Norman, of Boston, unanimously recommend, and, realizing that cost will be the great objection, they suggest, should the town build the proposed works, that the money be raised by issuing water bonds, payable in twenty years or more, and that the income from water rents be used to pay the interest, thereby preventing direct taxation and the increase of taxes.

The committee have gone over the ground carefully, and it is believed that what they recommend will be adopted. It is the most able town report we have ever seen.—*Boston Journal, Oct.* 7.

IN DANGER FROM A WEAK DAM.—PROVIDENCE, R. I., Oct. 9.—Fresh signs of weakness having been discovered in the Georgiaville dam, which holds a large body of water, eight miles above Providence, the Commissioner of Dams and Reservoirs this afternoon made a further representation to the Supreme Court of the danger, and the Court ordered that the Bernon Manufacturing Company forthwith draw off the water in the pond so far as can be done by the opening of the gates, and that the gates be kept open until further orders of the Court. The pond is nearly 40 ft. deep, and can be lowered only 9 ft. by the gates. If the dam should go out, a large business section of the city could hardly escape destruction.

COVINGTON, KY.—The surveys for the new reservoirs on Forest Hill are about completed. There is a strong probability that the question of erecting the reservoir will be submitted to the people at the coming January election.

THE last of the pipe-laying for the city water-works at Madison, Wis., was completed the other day. The twelve miles of mains will be tested this week by a pressure of 150 to 200 lbs. to the square inch.

FIGHTING AGAINST A DAM.—PITTSFIELD, Mass., Oct. 10.—The trial of the Smith Paper Company, of Lee, for maintaining a nuisance in the form of a dam across the Housatonic River, near Lenox, began to-day before Chief Justice Brigham. The indictment alleges that since 1876 the dam has set back the water over an expanse of low, flat country, which land the water alternately overflows and leaves bare, with the exception of stagnant water, which gathers in pools. From these pools steeches and smells arise which have been the cause of the fever and ague that has for three or four years past infected the neighborhood. The defense will ascribe the sickness to the unhealty condition of the residences.

THE WASHINGTON WATER-WORKS EXTENSION.—Major Lydecker has submitted a preliminary report to General Wright, the chief of engineers, U. S. A., on the extension of the water-works. No maps or plans accompany the report. General Wright will examine into it himself before placing the report before the Secretary of War. The details of securing the lands necessary, the surveys, plans, etc., have all to be agreed upon, and it will take some time yet before anything can be done. General Wright intends to push the matter as fast as possible.

WATER FOR RAILROADS.—The Wisconsin Central Railroad Company are doing away with wind-mills along their line and putting in engiees and pumps to fill their water tanks at the various stations.

GAS METERS.—One hundred new meters have been ordered in Minneapolis, Minn., since the gas light company reduced the price to $2.50 per 1,000 feet.

GAS VS. ELECTRICITY.—FOND DU LAC, Wis., Oct. 3.—A number of our leading citizens, comprising some of the heaviest taxpayers in the city, have petitioned the Common Council not to adopt the tower system of electric lighting now on trial in this city, alleging that it is unsatisfactory and that the city can be lighted much cheaper with gas.

THE Beloit Water Company will begin the construction of first-class city water-works by the 1st of May next.

THE Danville, Ill., Water Company was incorporated on the 9th. Capital stock, $125,000; incorporators, John Long, Clifton Rodes Barrett, and Harry H. Hodgson.

RAILROADS.

THE Roodhouse & Scottsville Railway Company has filed articles of incorporation. The road is to be constructed, commencing at Roodhouse, county of Greene, Ill., running thence in an easterly direction near or through Athensville in said county, to Scottsville, in the county of Macoupin. Incorporators: George P. Merrill, Milton McClure, R. B. Shirley, of Carlinville; James Walker, of Scottsville; James L. Patterson, John Jones, John Roodhouse, of Roodhouse, and William C. Shirley, of Stanton.

CHICAGO, Oct. 11.—The Chicago & Hannibal (Mo.) Railroad Company was incorporated at Springfield yesterday. The capital stock is $2,000,000, which Moses J. Richards, one of the leading incorporators, says has been all taken. The road is to be about 280 miles long, but the precise route is not yet determined.

THE Grand Trunk system now embraces 3,330 miles.

A ROAD, to cost $3,000,000, is to be built from Brooklyn, Ill., to Shawneetown.

THE Wheeling & Lake Erie Railroad has been opened from Wheeling to Detroit.

A SHORT line is to be opened up by the Missouri Pacific from Kansas City to St. Louis.

THE California Southern is completed to San Diego, 609 miles from San Francisco.

A RAILROAD is to be built between Buffalo and Toronto. It will be 10 miles shorter than any existing road.

TRAINS are to be running on Nov. 1 on the Chicago & Atlantic Railroad between Chicago and Marion, O., 250 miles.

THE New York, West Shore & Buffalo Railroad, when completed will, it is said, be the most expensive road ever constructed for the distance.

THE Denver & South Park division of the Gunnison branch is now completed to Gunnison, 207 miles from Denver, 72 miles from the main line at Buena Vista.

IN Texas, 1,461 miles of new roads were constructed last year, costing nearly $50,000,000. The State has now thirty-four railroads, aggregating 5,908 miles in length.

THE gross earnings of the Pennsylvania Railroad for July were $4,149,150 on the Eastern lines, the largest ever known. The net gain for the month was almost half a million dollars.

THERE are now employed on the New York, West Shore & Buffalo, and the New York, Ontario & Western Railroads, from Weehawken to Middletown and from Cornwall to Syracuse, 18,294 men, 115 steam and compressed-air drills, 14 steam excavators, and 4 dredging machines. There are also 3,131 horses and carts, 27 locomotives, 1,080 cars, 14 pile drivers, 76 steam derricks, 10 steam pumps, and 23 tugs, barges and canal boats.

IN round numbers 7,000 miles of railroad has been constructed so far this year, against 4,200 miles for same time last year. The earnings show a corresponding improvement. During July 68 roads, aggregating 51,020 miles, reported aggregate earnings of $30,019,504, or 10 per cent. more than for the same month last year. For seven months, ending July 31, 62 railroads, aggregating 49,470 miles, earned $198,633,720, or 12.4 per cent. more than last year.

A NEW NARROW GAUGE RAILROAD.—Since the recent survey of the proposed routes of the Bangor & Piscataquis Railroad extension has demonstrated the fact that the present location of the road is the proper one, the Massachusetts capitalists who control the great slate quarries of Monson, seeing that there is no prospect of the Bangor & Piscataquis road ever passing through the village, have decided to build a narrow-gauge road from their quarries to some point on the Bangor & Piscataquis. The gentlemen mentioned have secured the services of Mr. Wm. M. Brown, son of Hon. Arthur Brown, Superintendent of the Bangor & Piscataquis, as engineer, and the work of laying out the route has already been commenced.

NEW ILLINOIS ROAD.—The Illinois, Iowa & Minnesota Railroad Company have filed articles of incorporation with the Secretary of State; capital stock, $2,000,000. It is proposed to construct a line from Streator through the counties of La Salle, Bureau, Whiteside and Rock Island to a point on the Mississippi River near Princeton or Clinton, Iowa.

A NEW LINE.—The Wisconsin Central Railroad Company has commenced the construction of a new line from Chelsea, a station on the main line, to Rib Lake, a lumbering point sixteen miles northeast. The branch is to be completed this fall, and will involve an expenditure of $200,000. Other branches are contemplated that will prove not only beneficial to the people, but profitable to the corporation.

COST OF RUNNING A TRAIN.—A recent report of a prominent railroad gives the cost of running a train of less than 400 passengers per daily trip of 93 miles as follows:

Items of cost.	No.	Description.	Amount.
Wages of engineer	1	Day.	$3 30
Wages of fireman	1	Day.	2.[illegible]8
Wages of conductor	1	Day.	2.93
Wages of baggage master	1	Day.	1.95
Wages of brakemen	2	Day.	3.80
Anthracite coal for fuel	2.7	Tons.	6.94
Wood for kindling	.1	Cords.	.40
Water used	4	M. Galls.	.24
Oil and tallow for engine and tender, including lamps		Trip.	.02
Oil and grease for cars		Trip.	.19
Repairs of engine and tender	93	Miles.	4.33
Repairs of and refitting cars		Trip.	7.23
Hands at depots, extra engines, etc.		Trip.	2.01
Sundries for train, gas and all other expenses		Trip.	2.90
			$38.[illegible]8

Equal to 10.18 cents per passenger, at 376 passengers per train.

NEW STREET RAILROAD.—The Altoona & Allegheny Street Railroad Company, of Altoona, Pa., has filed articles of incorporation. Capital, $30,000.

A CHARTER was issued at Harrisburg on Friday last to the Gettysburg & Harrisburg Railroad Company, whose line is to extend from Hunter's Run, on the South Mountain Railroad, between Mount Holly and Pine Grove Furnace, to Gettysburg, a distance of 22 miles. The capital stock is $250,000, and is owned by Jay Cooke, J. C. Fuller, John M. Butler, Jay Cooke, Jr., R. J. Woodward, Charles D. Barney, Spencer Ervin, Philadelphia; Wm. H. Woodward, Carlisle, and Daniel King, Pine Grove Furnace.

ARTICLES of incorporation have been filed for record in the Clerk's office in Carlinville, Ill., of the Roodhouse Branch of the Burlington & Ohio River Railroad, with a capital stock of $200,000. The incorporators are George H. Merrill, Toledo, O.; M. McClure, Robert B. Shirley, Carlinville; Samuel J. Williams, Gillespie; Jas. Walker, Scottville; John Roodhouse, H. L. Paterson and George Jones, of Roodhouse.

THE Illinois, Iowa & Minnesota Railway Company filed articles of incorporation with the Illinois Secretary of State; capital stock, $2,000,000. It is proposed to start a line from Streaton to a point near Princeton or Clinton, Ia., on the Mississippi River, through the counties of LaSalle, Bureau, Whiteside and Rock Island. The first board of directors are: Ralph Plumb, Elmer Baldwin, Edwin Evans, J. D. Harvey, E. H. Thayer, A. Means and Alex. Campbell.

MEXICAN NOTES.—CITY OF MEXICO, Oct. 10.—The Government has contracted with Delfin Sanchez for the construction of the whole Tehuantepec Railroad. A Stock Exchange has been organized without a charter by European brokers under the auspices of the Mexican National Bank, and will be opened to-morrow.

ARTICLES of incorporation have been filed in Illinois for the Northwestern Construction Company, the principal office to be at Dubuque. The company will construct and equip the railroad lines of the Chicago, Freeport & St. Paul Railroad Company. The capital stock of the new construction company is fixed at $1,000,000.

PROPOSALS are wanted to build a 2 ft. gauge railroad, from Skowhegan to Athens (Maine), a distance of 12½ miles. The location has just been completed, and the work will be let as soon as bids can be obtained. For information, address A. S. C. Hall, East Madison.

SKOWHEGAN, Oct. 8. Yours, S. W. BATES.

CONTRACTS LET.

ANNUAL REPORT.—We learn from the advance sheets of the forthcoming annual report of the Builders' Exchange, Cincinnati, that during the year last past a total of 34,000 cubic yards of sand was used in connection with building in that city at a total cost of over $120,000; and that the amount of lime used was 600,000 bushels.

OSGOOD & MCNAUGHTON, of Albany, N. Y., have received an order from the Panama Railroad Company for one of their combined steam excavator and derrick cars.

AMERICAN CONTRACTS FOR AN EDINBURGH FIRM.—Messrs. Stuart & Co., Edinburgh, have just completed contracts for laying with their "granolithic"—the material put down some years ago on the south side of Princes street—the sidewalks of the Pennsylvania avenue, Washington, and the broad pavements surrounding the new post-office, Philadelphia. The pavements in each case are nearly 20 ft. wide, and the contracts amount respectively to 20,000 square yards, costing about £8,000, and 15,000 square yards, costing about £6,000.—*Contract Journal, London.*

NEWPORT, Oct. 10.—The contract for dredging the Providence River was to-day awarded to the Atlantic Dredging Company, Brooklyn, at 16 cents per cubic yard. The contract for excavating Taunton River was awarded, one portion to W. H. Beard, of Brooklyn, and the other portion to J. H. Fenner, of Jersey City. The contract for excavating Little Narragansett Bay in Rhode Island and Connecticut was awarded to the Hartford Dredging Company, of Hartford, at 20 9-10 cents per cubic yard.

BIDS were opened at the Treasury Department Monday for repairs to the revenue steamer Boutwell at Baltimore, as follows: Maister & Renney, of Baltimore, $17,000; Ramsey & Co., of Baltimore, $20,000.

THE CENTRAL BRIDGE, LOWELL, MASS. CONTRACT AWARDED.—The Central Bridge Committee have awarded the contract for the superstructure. There was a general interchange of opinion in regard to the merits of the various bridges offered, and a discussion of prices, etc. The committee determined to make the award among five of the dozen bidders, rejecting the rest for informalities or other reasons. It was finally voted to give the contract to the Morse Bridge Company of Youngstown, Ohio, the lowest bidders, the work to be done to the satisfaction of the City Engineer. The Mayor was authorized to sign the contract on behalf of the city. The following were the five proposals considered:

Morse Bridge Co., Youngstown, O.	$51,500
Wrought Iron Bridge Co., Canton, O.	58,853
Phœnixville Bridge Works, Phœnixville, Pa.	54,580
Boston Bridge Works	56,600
Corrugated Metal Co., Berlin, Conn.	60,862

The bids for the lock and lock gates at the Bridgeport (Chicago) pumping-works were opened recently, the lowest bidder being O. B. Green, who offers to take the contract for $35,000.

CANALS.

TO BUILD A SHIP CANAL.—CHICAGO, Oct. 10.—The Illinois Improvement Company, of Chicago, was incorporated at Springfield to-day. Its object is to build a ship canal from Lake Michigan to Grand Crossing, a point at which all the Eastern trunk lines converge.

BUILDING.

HOUSTON COUNTY, Minn., is to have a new court-house, patterned after that at St. Peter, which cost $22,000.

A NEW SCHOOL HOUSE, to cost $20,000, is to be built in Minneapolis, Min., this year.

NEW SCHOOL HOUSE.—Ishpeming, Mich., is to have a $15,000 school house.

LABOR.

A STRIKE ON THE NORTHERN PACIFIC.—SAN FRANCISCO, Oct. 10.—Twenty-five hundred white construction employés of the Northern Pacific Railroad in Montana struck on Saturday on account of an advance in the board rate of half a dollar per week. There was no violence. The supervising engineer telegraphed that the new board would be maintained. It is thought the men will return to work. The Chinese, numbering 5,000, were not in the strike.

BRIDGES.

NEW BRIDGE AT BISMARCK.—About the 18th inst. five large engines from the west and five from the east will meet on the new bridge spanning the Missouri at Bismarck for the purpose of testing it and formally opening it for traffic.

NEW BRIDGE ACROSS THE MISSOURI.—It was stated yesterday that the Burlington and Quincy people are considering the project of building a new bridge across the Missouri at Randolph Point, thereby securing an independent entrance into Kansas City, without recourse to the Hannibal & St. Joseph bridge. The Milwaukee & St. Paul also desires entrance into Kansas City, and will be likely to join hands with the Burlington in the project of building a new bridge if it assumes a practicable shape.

ON THE CONSTRUCTION OF THE SECOND AVENUE LINE OF THE METROPOLITAN ELEVATED RAILWAY OF NEW YORK.*

BY THE LATE G. THOMAS HALL, MEMBER A. S. C. E.

[Read April 20, 1881.]

In presenting a paper upon the Construction of the Second Avenue Line of the Metropolitan Elevated Railway in New York, of which Mr. Wm. F. Shunk is Chief Engineer, the writer, who has been the Division Engineer in charge of the work, feels impelled to apologize to the members of the Society for its length and the recitation of numerous details, not easily avoided, however, in a comprehensive treatment of the subject. It has been written in the midst of the busy daily duties of professional labor.

DESCRIPTION OF THE ROUTE.

The line departs from the joint structure of the Metropolitan Elevated Railway and the New York Elevated Railroad at Chatham square, by curves of 230 and 250 feet radii for the up and down-town tracks respectively. Expressed metrically, with radii of 70.10 and 76.198 metres. The up-town track 55 deg. 30 ft. 45 in. and the down-town track 36 deg. 10 ft. 40 in. curvature; thence through Division street by tangent, excepting the up-town track, which has a reverse curve of 8 deg. 18 ft. total curvature and radius of 1,910 feet (582.157 m.), to form a parallel track; thence into Allen street by curves of 210 feet (64.007 m.), radii, with curvature of 63 deg. 08 ft.; thence through Allen street by tangent to Houston street; thence by curves of 1,910 feet (582.157 m.), radii and curvature of 7 deg. 41 ft. into First avenue; thence by tangent through First avenue to Twenty-third street; thence with a curvature of 90 deg. and radii respectively of 136 feet and 110 feet (41.452 and 33.527 m.), on the up and down-town tracks; thence by tangent through Twenty-third street to Second avenue, and into Second avenue by curves similar to those at First avenue and Twenty-third street, excepting that those of the up and down-town tracks of the former correspond respectively to those of the down and up-town tracks of the latter; thence by tangent through Second avenue to One Hundred and Twenty-ninth street or the Harlem river.

TABLE NO. 1.

TABLE OF LENGTHS OF TANGENTS AND CURVES.

LOCATION.	EAST TRACK.		WEST TRACK.	
	Feet.	Meters.	Feet.	Meters.
Chatham sq. Curves....	222.80	67.908	157.80	48.907
Division st. Tangent ..	1,004.60	306.196	991.10	302.082
Allen street Curves ...	231.12	70.444	231.12	70.444
Allen street Tangent ..	3,206.67	977.375	3,209.61	978.271
Houston st. Curves....	256.10	78.058	256.10	78.058
First avenue Tangent ..	5,448.38	1,660.636	5,438.50	1,657.625
First avenue Curves...	219.90	67.024	172.79	52.665
Twentythird st. Tangent	503.00	153.314	503.00	153.314
Second av. Curves....	172.79	52.665	219.90	67.024
Second av. Tangent ..	27,942.00	8,516.566	27,939.00	8,515.651
Total lineal ft. and metres.....	39,207.36	11,950.183	39,118.92	11,923.228
Equals miles and kilo metres ...	7.42 miles	11.950 kil.m.	7.409 miles	11.923k.m.

The curves are but little more than two per cent. of the length of the whole line.

The successive steps in the construction of an elevated railway are not wholly different from those which occur in building on the surface, as will be seen by the following natural order to which we conformed, viz.:

1. Preliminary survey.
2. Location of "layout."
3. Construction of foundations.
4. Setting cast-iron bases for columns.
5. Erection of iron structure.
6. Track structure and track laying.
7. Painting.

PRELIMINARY SURVEY.

In order that no mistakes should be made in projecting a layout, or in the succeeding work of construction, this survey should be made, as it was, with the greatest care. The obstacles to the attainment of such a result in the crowded business streets of a city like New York are only known to engineers whose patience and good nature have similarly been taxed quite up to the limit of elasticity.

It may be surprising to some to learn that no errors greater than 1 in. per 1,000 ft. (.0254 m. per 304.795 m.) of horizontal measurement, and $\frac{1}{190}$ of a foot per 1 ft. (.0016 m. per .305 m.), in elevation were allowed.

The first, and a very important step in the survey, was the adoption of a convenient base line that could be used until the final completion of the railway. It was located on the easterly sidewalks, far enough from the curb line to escape any possible interference from the excavations for piers. No small difficulty was experienced in locating these base lines, especially on the avenues, where they are from 1 to 5 miles long, the requirements being a straight line parallel to the axis of the street or avenue. There is no angle in the First avenue base line, but to overcome several irregularities in the Second avenue line, and to prevent encroachment with our columns on the horse-car tracks, a few slight angles of a few seconds each were permitted on the base line; these, where it was possible to do so, were located on summits of grades, and cannot be detected with the eye.

After permanently establishing the base lines, the longitudinal distance was measured with wooden rods 25 ft. (7.619 m.) in length, the measurement being guided by a transit man. These rods were made by Young, of Philadelphia, and pronounced by him to be accurate by the United States standard. Several auxiliary test standard lengths were first laid off at convenient points, where the rods were tested every morning for the day's measurement. Full stations were thus located and permanently marked every 100 ft. (30.479 m.), and sub-stations every 25 ft (7.619 m.). Following the measuring party was another small party, whose duty it was to locate all obstacles with steel tape from some of the full or sub-stations. It was found of the utmost importance in the subsequent projection of a layout, that all such prominent features as sewer basins, fire hydrants, man-holes, lamp posts, telegraph poles, sewer, gas, and water mains, curb lines, house lines, vaults, chimneys, horse-car tracks, and large, important and public buildings, should be accurately measured and mapped. A location for the columns was then decided upon, and spotted upon the map for construction or verification. The spacing and arrangement of the columns on the street or sidewalk to support the structure is called the "layout." After the columns had been marked off at their proper sites, elevations thereat were taken for the purpose of establishing grade and determining the length of the columns.

For the purposes of construction, bench marks were permanently established every two blocks, or about 500 ft. (152.396 m.) apart.

CONSTRUCTION OF FOUNDATIONS.

The requirements imposed by the Board of Commissioners of Rapid Transit in regard to foundations were:

1. The foundations, where necessary, shall be increased in area, so that in no case shall a weight greater than 2,000 lbs. to the square foot come upon any base (9765. kgs. per sq. m.).

EXHIBITS OF TESTS OF ROSENDALE CEMENT, USED ON SECOND AVENUE EXTENSION M. E. R.

BRAND OF CEMENT.	PROPORTION OF MIXTURE: TIME OF SETTING: BREAKAGE PER SQUARE INCH.												Temperature.		Fineness
	Neat.			Sand, 1; Cement 1.			Sand, 1½; Cement, 1.			Sand, 2; Cement, 1.					
	Time.	Breakage. Lbs. per sq. in.	Breakage. Kg. per sq. c. m.	Time.	Breakage. Lbs. per sq. in.	Breakage. Kg. per sq. c. m.	Time.	Breakage. Lbs. per sq. in.	Breakage. Kg. per sq. c. m.	Time.	Breakage. Lbs. per sq. in.	Breakage. Kg. per sq. c. m.	Air.	Water.	
F. O. Norton	24 hrs.	44	3.09	24 hrs.	40	2.81	24 hrs.	40	2.81	48 hrs.	39	2.74	Avg. tem. 72° F.	Avg. tem. 68° F.	90:100
"	"	50	3.52												
"	"	42	2.95												
"	"	58	4.08	"	58	4.08	"	48	3.38	"	40	2.81			
"	"	50	3.52												
"	"	65	4.57	48 hrs.	60	4.22	48 hrs.	50	3.52	"	45	3.17			
"	7 days.	80	5.63	7 days.	60	4.22	7 days.	40	2.81	7 days.	40	2.81			
"	2 mths.	360	25.32	2 mths.	220	15.47	2 mths.	189	13.29	2 mths.	174	12.24			
"	5 "	560	39.38												
"	6 "	530	37.27												
Newark & Rosendale......	24 hrs.	44	3.09										74° F.	70° F.	93:100
"	"	46	3.24	24 hrs.	40	2.81	7 days.	49	3.45						
"	48 hrs.	42	2.95												
"	24 hrs.	38	2.67	"	36	2.53	"	52	3.66	2 mths.	114	8.06			
"	"	42	2.95	"	34	2.39									
"	"	45	3.17	"	32	2.25	1 mth.	175	12.31						
"	3 mths.	325	22.85	......	......	......	......	......	......	5 mths.	275	19.34			
New York Cement Company......	24 hrs.	42	2.95	24 hrs.	31	2.18	24 hrs.	36	2.53	......	......	......	74°	70°	91:100
" "	48 hrs.	42	2.95												
" "	7 days	62	4.36	......	......	......	......	......	......	......	......	......	72°	68°	
" "	24 hrs.	48	3.38												
" "	"	48	3.38	48 hrs.	38	2.67									
" "	"	50	3.52	......	......	......	24 hrs.	28	1.97	24 hrs.	30	2.11	71°	59°	
Hoffman & Lawrenceville......	24 hrs.	48	3.38	......	......	......	......	......	......	24 hrs.	32	2.25	74°	70°	92:100
"	"	52	3.66												
"	"	42	2.95												
"	7 days	68	4.78	......	......	......	......	......	......	7 days.	38	2.67	70°	67°	
Rocklock......	24 hrs.	39	2.74												94:100
"	"	58	4.08												
"	"	62	4.36	......	......	......	24 hrs.	38	2.67	7 days.	87	6.12	78°	70°	
"	"	47	3.31	......	......	......	7 days.	94	6.61	......	......	......	"	"	

2. Good hydraulic cement shall be used in the masonry, and Portland cement of the first quality shall be used in case the foundations are constructed of concrete. If bricks are use, they shall be hard burnt, and of the best quality.

No foundations were constructed of concrete; all the other requirements were rigidly adhered to. Their classification was as follows:

1. Standard street piers.
2. Standard sidewalk piers.
3. Special street piers.
4. Special sidewalk piers.

The Standard Street Pier was built in the driveway on firm ground where no obstacles were met. The pits were opened 9 ft. (2.743 m.) square, and excavated to a depth of 5 ft. 6 in. (1.676 m.) below the bottom of the base casting, which usually made the excavation about 7 ft. (2.133 m.) below the street surface. The bottom of the pit was then examined with a sounding rod, and, if found satisfactory, was leveled, and, where deemed expedient, compacted with rammers. The sides a foot (.305 m.) high from the bottom were then shaped and smoothed to inclose a bed of concrete 8 ft. (2.438 m.) square and 9 in. (.2287 m.) thick. The concrete was composed of broken stone, not exceeding 2½ in. (.0635 m.) in the largest dimension, four parts; clean, sharp sand, two parts; American hydraulic cement, one part. The cement and sand were first mixed with a minimum amount of water, after which the broken stone, being well wet, was added, the whole mixture being then thoroughly incorporated on a tight board platform, was deposited in one layer in the pit, and rammed till the soft material flushed to the surface; before setting, pockets were scooped in the surface of the concrete, which were partially filled with thin hydraulic mortar subsequently to receive the bolt washers and heads. On top of the concrete were laid two stones, averaging 5 in. (.127 m.) thickness and 3 ft. by 7 ft. (.914 m. by 2.13 m.) laid so as to offer a base of 7 ft. (2.13 m.) square. These large stones served the purpose of anchorage for the bolts, as well as support for the brick pier. Fig. 1 gives plan and elevation of standard street pier; fig. 2, standard sidewalk pier.

Standard Sidewalk Piers.—Pits for the piers were excavated 12 ft. (3.66 m.) deep. The concrete footing was 8 ft. 6 in. (2.59 m.) square, and 12 in. (.305 m.) thick, deposited in two layers. The height, from bottom of concrete to bottom of socket, in base casting, was 10 ft. 6 in. (3.2 m.).

The height from bottom of foundation stones to top of brickwork was 9 ft. 3 in. (2.82 m.); in all other respects the piers corresponded to the standard street piers previously described.

Special Street Piers were those which from natural or artificial causes could not be built to the standard plan. The reasons for departing from the regular form of construction were foundations in quicksand, muck, made ground, or other soft bottom, adjacent or underlying water and gas mains, sewers, with their appendages of manholes, basins, culverts, etc.

Special Sidewalk Piers were those required when vaults or other subterranean obstacles were encountered.

The total number of piers built to date is 2,014, of which 1,496 are special. Of the latter number, 198 rest on piles. The total number of piles driven was 3,310; the average length driven was 20 ft. (6.1 m.). They were spruce, straight, straight-grained and smooth, free from large knots, divested of bark, not less than 12 in. (.305 m.) at the butt after sawing off, and 8 in. (.201 m.) at the small end. They were driven to hard bottom, or until the set did not exceed one-fourth of an inch (.0063 m.) under the blow of a ram weighing 1,200 lbs. (544.3 kg.), falling 8 ft. (2.44 m.). The piles were hooped for driving, and sawed off horizontally 1 ft. (.305 m.) below mean high tide level, their heads then being surrounded with concrete. The usual form of capping and flooring was used.

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* From the Transactions of the American Society of Civil Engineers. Vol. X. April, 1881.

Elevations of four street piers and an isometrical drawing of one are given in figs. 3, 4, 5 and 6 as fair samples of the prominent obstructions encountered on First and Second avenues. The frequency of the obstacles met with is made apparent by the fact that 74.3 per cent. of the piers are special.

The materials for concrete and hydraulic mortar were compounded by actual measure, and all cement was subject to inspection and test before use. The specifications for cement required it to be capable of resisting a tensile strain of 50 lbs. to the square inch (3.52 kg. per square cm.) after thirty minutes exposure in air and 24 hours immersion in water. The results of some tests made by the inspector of sand and cement are given in Exhibit 1, and show results from cement obtained from five different manufacturers. Much good sand was obtained from the excavations at different points along the work. The remainder was delivered on scows from "Cow Bay," Long Island, or "The Kill," on Staten Island. The latter, although much more difficult to obtain, was by far the better sand; both kinds, however, were required to be "bank sand."

These mixtures and most of the tests (except the long time tests) were made during May, June, July and August, 1879, from the cement as received from the mills. A much larger number of tests, however, were made. From accepted brands only a portion have been selected for this tabulation, which are probably sufficient to show the strength of the Rosendale cement used on short and long time tests for tensile strength.

Since writing the bulk of this paper the writer had occasion to build some twenty piers to connect the Metropolitan Elevated Railway on Eighth avenue with the Harlem River Bridge. As the cost of materials and labor have largely increased since the construction of the Second avenue line, an epitome of this work is shown in Appendix I.

It may be of interest to note some experiments made by the writer to ascertain the amount of shrinkage in the materials combined to make the hydraulic mortar used. The measurements of the sand, cement and water were carefully made in a box containing exactly one cubic foot (28.3 litres). It was found that in the mixture, including the water that was used, there was a total shrinkage of 37 and 33$\frac{4}{10}$ per cent., respectively, for two different tests. Omitting the water in the deduction, it was found there was a shrinkage of 22½ and 25 per cent. in the dry materials, after being mixed into mortar for use.

The following table shows the proportions used:

TABLE No. 2.

QUANTITIES IN CUBIC FEET.

CEMENT.	SAND.	WATER.	MIXTURE.	MORTAR MADE.	REMARKS.
4	8	2¾	14¾	9 3-10	Exp. (1)
3	6	2	11	6¾	" (2)

QUANTITIES IN LITRES.

CEMENT.	SAND.	WATER.	MIXTURE.	MORTAR MADE.	REMARKS.
113.3	226.5	77.8	417.6	263.4	Exp. (1)
85	169.9	56.6	311.5	191.1	" (2)

From these results it would appear that for any known quantity of cement mortar required, 25 per cent of the amount should be added to the dry materials for shrinkage, the materials being used in the foregoing proportions.

The total number of bricks used in foundations, including the station piers built to date (Feb. 1, 1881), is 14,841,196, or an average of 7,309 per pier. The Haverstraw brick, as laid in these foundations, numbered by actual count from 19 to 21 per cubic foot (0.671 brick per litre), the variation being probably due to the thickness of joint.

CAST IRON BASE CASTINGS.

There were six patterns of base castings, used and designated as follows: A, AD, AE, B, BD and BE. The calibre of the first three patterns is 13½ in. (.343 m.) for Phoenix columns, whose cross section area ranges from 36 to 39 square inches (232.3 to 251.6 sq. c. m.).

The calibre of the remaining three patterns is 13¾ in. (.35 m.) for the same style of column, having a cross section area of 42 to 45 square inches (271 to 290 sq. c. m.). As the different patterns of the two calibres are essentially the same, only differing one-fourth of an inch (.0063 m.) in diameter, sketches of three patterns only are shown in fig. 7.

The base castings were delivered by the company on the curb line opposite the piers where they were to be set. The proper elevation, together with the lateral and longitudinal adjustment of the base, was given by the engineer in charge, who also directed how the work should be done. The restoration of the street surface was made in all cases acceptable to the city street authorities.

The following tables show the actual cost of material and labor for setting the base castings by days' work, where the pier had been built and street restored before the base casting was set:

TABLE 3.

FOR A AND B BASE CASTINGS.

	Time.	Cost.
Time and cost of uncovering pier—2 men at 15 cents per hour	1⅛	.35
Time and cost of moving base from sidewalk to pier—5 men at 15 cents per hour	½	.40
Time and cost of erecting derrick and setting base casting—5 men at 15 cents per hour	4-5	.60
Time and cost of repaving 25 square feet —2 men at 25 cents	1	.50
Time and cost of washing, tarring and bricking—2 men at 25 cents	⅝	.35
Time and cost of refilling—2 men at 15 cents	½	.15
Time and cost of preparing cement mortar—1 man at 20 cents	½	.10
Foreman and night watchman		.50—2.95
Amount of cement used—¼ bbl. at $1		.25
Amount of sand used—¼ bbl. at $1.25 per cubic yard		.06
Number of bricks used—32 at $10 per M.		.32
Amount of refuse carted away—⅛ cubic yard		.38
Amount of sand for paving 2½ cubic feet.		.11
Amount of coal tar, cement wash, &c.		.10
Oil for lamps, and incidentals		.05—1.26
Total cost		$4.21

TABLE NO. 4.

FOR AD, AE, BD, AND BE BASE CASTINGS.

	Time.	Cost.
Time and cost of uncovering pier—2 men at 15 cents per hour	1⅔	.50
Time and cost of moving base from sidewalk to pier—5 men	⅘	.60
Time and cost of erecting derrick and setting base castings—5 men	1¼	.94
Time and cost of repaving 40 square ft.—2 men at 25 cents per hour	1½	.75
Time and cost of washing, tarring and bricking—2 men at 25 cents an hour	1	.50
Time and cost of refilling—2 men at 15 cents per hour	¾	.23
Time and cost of preparing cement—1 man at 20 cents per hour	¾	.15
Foreman and night watchman		.63—4.30
Amount of cement used—½ bbl. at $1		.50
Amount of sand used—¼ bbl		.10
Number of bricks used—60 at $10 per M.		.60
Amount of refuse carted away—⅛ cubic yard		.56
Amount of sand for paving 4 cubic ft.		.18
Amount of coal tar, cement wash, etc.		.15
Oil for lamps, and incidentals		.05—2.14
Total cost		$6.44

Where the base setting followed the construction of the brick piers, it was found that thirty-five per cent. of the above cost was saved.

The base castings north of Eighty-seventh street were set the year following the pier construction, and done by contract at the following prices:

For A and B base castings, including all labor and materials, $3.75.

For AD, AE, BD and BE base castings, including all labor and materials, $5.25.

A saving of about eleven per cent. on the former, and about eighteen per cent. on the latter style of bases.

The average number set per day by days' work or by the company was ten, while the average number set per day by contractor was fifteen. It might be well to state, in this connection, that the contractor gave his undivided, personal attention to the work.

The following table shows the average weight of the different kinds of bases used, number of each pattern, and total weight of all in tons of 2,240 pounds and 1,000 kilograms:

TABLE NO. 5.

WEIGHTS OF CAST-IRON BASES.

No. used.	Pattern.	AVERAGE WEIGHT.		TOTAL WEIGHT.		
		Lbs.	Kgs.	Tons of 2240 lbs.		Tons of 1000 kilograms.
				Tons	Lbs.	
1,463	A	3,204	1,453.32	2,092	1,336	2,126.21
49	A D	5,533	2,509.75	121	0,430	127.98
50	A E	6,026	2,733.37	134	0,840	136.67
400	B	3,203	1,452.78	565	0,854	584.60
24	B D	5,510	2,499.32	58	1,840	59.98
5	B E	6,048	2,743.35	13	1,300	13.72
2,000				1,005 $\frac{88}{100}$ tons.		3,054.10

The specifications for cast-iron column bases required them to be made of the best No. 2 Lehigh pig metal, or its equivalent in quality, three tons to one ton of machinery scrap.

The mixture was tested by taking a bar therefrom 1 in. (.0254 m.) square, and 1 ft. (.305 m.) between supports, which was required to sustain at its middle point one gross ton (1,016 kgs.), without fracture, the casting to be perfect in shape, the bolt-holes spaced exactly and cored square to the base. The cores for the barrels to be made without draught, and blackened to get a smooth casting; great care was necessary in adjusting the barrels, and the spherical bearing at the bottom of the socket was cast chilled. The casting was then permitted to cool slowly, remaining in the sand not less than twenty-four hours. The bases described, by their peculiar form of construction, were difficult to cast. The distribution of the metal in the barrel, bottom of socket, ribs and flanges, while well calculated to resist the incumbent strains upon them, necessitates great care in founding. The iron, in cooling, shrinks along the ribs, while the expansion, owing to the large amount of metal in the centre of the base, still continues at the bottom of the socket.

These reactionary forces sometimes caused a bursting of the base. Other reasons, also, combined to produce similar results, such as the use of too hard iron, pouring while too hot, cooling the casting too quickly, or moulding in damp sand, the latter tending to ruin the core by expansion of air or steam, or both, and thereby rendering the bottom of the socket too thin for use. The bases were subjected to a rigid inspection by striking with a sledge, measuring the various parts and scrutinizing with a critic's eye before leaving the foundry. The final act of setting the base in position was also a good test of its perfect construction. Not a few were rejected in the last act. The bases were set to a given elevation—an elevation of top of base being previously determined for the whole line, chiefly dependent upon the grade of the streets. A bed of hydraulic mortar, from one-half to three-fourths of an inch (.0127 to .0191 m.), was given them that they might always be brought to a true elevation and to furnish a perfectly even bearing when screwed down to the brick pier. The end of the bolts, together with the nuts, were then covered with a thick coat of coal-tar, and the whole base given a wash of pure cement mortar where the bases occur in the driveway. They were further protected by cast-iron bell-shaped fenders, which also prevent the wheel hubs of passing vehicles from striking the iron columns. The intervening space between the shell of the fender and the base casting was filled with cement mortar. Fig. 98 represents a fender in position, the base and column being shown by dotted lines.

ERECTION OF IRON STRUCTURE.

The iron structure is composed of Warren longitudinal girders of the deck system, whose upper chords rest upon the top chords of transverse girders of a similar character, supported by six segment wrought-iron columns of the Phoenix pattern. The transverse girders have a double-triangular system, whereas the longitudinals are of the plain triangular type. The longitudinal girders are set in pairs under each track, 5 ft. (1.524 m.) between centres. They are 4 ft. (1.219 m.) deep from out to out of chord angles.

The bottom chords of transverse girders are flush with the under surface of longitudinals, and made rigid therewith by plates and bolts. The transverse girders through Division and Allen streets, First avenue and Twenty-third street, are sized and fitted for the support of three tracks, and through Second avenue for four tracks.

Transverse girders weigh about 200 lbs. per lineal foot (297.4 kg. per m.).

Longitudinal girders weigh about 130 lbs. per lineal foot (193.5 kg. per m.).

Bracing, etc., weigh about 8 lbs. per lineal foot (11.9 kg. per m.).

"A" calibre columns weigh about 350 lbs. per yard (173.7 kg. per m.).

"B" calibre columns weigh about 420 lbs. per yard (208.4 kg. per m.).

The first step in the erection of the iron work was dropping the columns into their appropriate base castings. This was easily accomplished by means of a derrick wagon, by which seven men and a team of horses were able to set in place an average of 39 columns not exceeding 20 ft. (6.096 m.) in length; or ten columns not exceeding 50 ft. (15.240 m.) in length per diem. The space between the barrel of the base casting and the columns was then caulked with oakum to keep out the water prior to using the cast-iron cement, and the columns filled with cement mortar in proportion of two parts sand to one of cement.

The columns were held temporarily in place by inserting iron wedges inside the rim of the base casting. The girders were raised by a traveler on the structure. The power used was a 15-horse power engine, boiler shell, 3 ft. × 6 ft. (.914 m. × 1.828 m.). The force needed was 12 men besides the engine man. With the power and force named the contractor raised an average of 66 girders per diem of ten hours, equaling 200 tons (203.22 tons kg.), using one-fourth ton (253.11 kg. of coal).

The iron girders all being in place, the lateral bracing was then adjusted and riveted and the columns very carefully plumbed with heavy iron plumb-bobs, and in many cases of long columns with a transit instrument. After being brought to a vertical position they were thus held by jack-screws and braces until the cast-iron cement had been substituted for the oakum.

The cast-iron cement used consisted of the following proportions: One ounce (28.3g.) of sal ammoniac to one gallon (3.79 l.) of water. The cast-iron turnings or borings were mixed with a minimum amount of the solution and left standing about half an hour before using, to "warm up." The mixture was then dropped in layers of ⅛ in. to ½ in. (.0032 m. to .0127 m.), not to exceed the latter, and very thoroughly rammed with iron rammers driven by vigorous blows of a hammer. For a "B calibre" base about 130 lbs. (58.97 kg.) of borings were required to perfectly cement the column and its base casting. For a base of "A calibre" about 100 lbs. (45.36 kg.) were needed. It took about 48 hours to complete all evaporation, whereupon the cement became as hard as the iron itself. Much care was needed in preparing this cement. Unless sufficient water was used the cement would heat and be spoiled. The addition of sulphur one part to eight parts of sal-ammoniac hastens the process of hardening, but if time is allowed it sets more firmly without the sulphur. Hence, the use of sulphur was abandoned. It was also found absolutely necessary that the iron borings should be perfectly clean and free from rust. As an illustration of the efficiency of this cast-iron cement, it may be interesting to know that when occasion offered a column was removed from a cast-iron base after it had been thus cemented, whereupon it was found stronger than the base itself, the latter breaking first under powerful blows of a sledge.

I.—TRACK STRUCTURE AND TRACK LAYING.

1. The gauge of the track on tangents is 4 ft. 8½ in. (1.435 m.). On curves of 600 ft. (182.9 m.) or less it is 4 ft. 9 in. (1.448 m.).

2. The track material consists of:

(a.) Southern yellow pine cross-ties 6 in. × 6 in. × 8 ft. (.1524 m. × .1524 m. × 2.438 m.), except on curves, crossings and turnouts, where greater lengths and larger sections were frequently used. Every third cross-tie on each track of the main line is a lookout tie 12 ft. (3.657 m.) long.

(b.) Southern yellow pine guard timbers 6 in. × 8 in. × 30 ft. (.1524 m. × .2032 m. × 9.14 m.) long and upwards for straight lines, and white oak guard timbers of like lengths 5 in. × 8 in. (.127 m. × .2032 m.) section for sharp curves and their approaches.

(c.) White oak bevel and distance blocks, cap stringers and shims for sharp curves.

(d.) Steel rails weighing 63 pounds per yard (31.26 kg. per m.), and usually 30 ft. (9.14 m.) long.

(e.) Fish plates, screw bolts, lag screws, clips, angle bar and strap-iron guards, blunt bolts, spikes and nails. All materials were delivered along the line, in the street, by the company, the contractor thereon receipting for the same and assuming all further responsibility. The accepted bids for track work were those of Messrs. D. R. Kelly and Quinn & Flinn, all of New York city. The following table shows the amounts and respective prices credited to each:

TABLE No. 6.

CONTRACT PRICES PAID FOR TRACK WORK, AND AMOUNT DONE BY EACH.

NAMES.	TANGENTS. Price.	TANGENTS. Length.	CURVES. Price.	CURVES. Length.	3 PLANK WALK. Price.	3 PLANK WALK. Length.	SWITCHES. Price.	SWITCHES. Number.	FROGS. Price.	FROGS. Number.	REMARKS.
	IN LINEAL FEET.										
D. R. Kelly....	43c.	50,764.4	80c.	1,628	....	....	$3.00	35	$4.00	41	
Quinn & Flinn.	35c.	37,840.	....	...	3c.	31982	12.00	23	3.00	26	Turnouts and crossings all estimated as tangents. Switches to include furniture, and in working order.
	IN METRES.										
D. R. Kelly....	$1.41	15,481	$2.62½	496.2	....	..	$3.00	35	$4.00	4.	
Quinn & Flinn	1.46	11,533	.....	.....	9.2c	9,748	12.00	23	3.00	26	

II.—STRAIGHT LINES.

The cross-ties were spaced 18 in. (.4572 m.) from centre to centre, excepting at rail joints, where shoulder-ties were used, spaces 6 in. (.1524 m.) in the clear, from the joint tie. They were laid at right angles to the centre line of the track, with the outer ends in range. Wrought-iron clips and lagscrews were used to fasten them to the flanges of the longitudinal girders, two clips and two lagscrews to each cross-tie alternately inside and outside of the girders. The top of the cross-tie over each transverse girder was always true grade; whenever camber showed itself in the longitudinal girders it was taken out by adzing the under surface of the cross-ties. No shimming was allowed in any case. The rails are those known to the trade as "Erie Pattern," made of Bessemer steel with $\frac{25}{100}$ of one per cent. of carbon.

They were furnished by the Albany Rensselaer Iron and Steel Company, and met satisfactorily all requirements of the company's inspector. A test bar ¾ in. (.019 m.) square, and one foot (.305 m.) long was taken from each charge and required to bend 80 deg. without breaking, under a sudden pressure, on bearings of 8 in. (.2032 m.) asunder. Two bars out of three to stand this test in order that the charge might be rated first-class. If two out of three broke the charge was rated second-class and rejected. An official test record was kept of all charges, and open to the company's inspection. A template for section was furnished by the company. It was found that although the manufacturers were very successful, generally, in meeting the requirements of the specifications, yet it was quite common to discover a slight "kink" near the end of the rail; this could not well be avoided with the straightening machine then in use at the mills.

They are placed to break joints in each track, the ends of them, on one side, laid as nearly as possible opposite the middle of those on the other side, and the joint made exactly over the middle of the tie, each rail was then spiked with two spikes in each cross-tie. The joints were left open ¼ in. (.0061 m.) when the temperature was below Fahrenheit zero; a scant ¼ in. (.0064 m.) between zero and 32 deg.; $\frac{3}{16}$ in. (.0048 m.) between 32 deg. and 50 deg.; ⅛ in. (.0032 m.) between 50 deg. and 80 deg.; and $\frac{1}{16}$ in. (.0016 m.) above 80 deg. Only metal shims were used in regulating the spaces.

The guard timbers were laid both sides of the steel rails, and exactly 10 in. (.254 m.) apart, the inner one being 3½ in. (.0889 m.) in the clear from the gauge side of the track rail when complete, with strap iron. They were framed at the ends with a dovetail halving splice 9 in. (.2286 m.) long, tapering one inch (.0254 m.). The splices in all four guard timbers were made to break joints; screw-bolts were used to fasten the timbers at the joints. Each guard timber was, as a general rule, bolted to alternate cross-ties, the inside and outside timbers being bolted in pairs respectively to the same tie, they were secured to the girder flanges by clips above the nuts of the screw bolts, the heads and washers of which were set down into a cup at top, bored with a 2 in. (.0508 m.) auger, deep enough to sink the head slightly below the top surface of the guard timber and permit the screw end of the bolt to project about ⅛ in. (.0032 m.) below the nut after screwing up for upsetting. The auger-hole cup was filled completely with a paste of Portland cement, and smoothed off a little crowning to shed water, prior to painting. All the bolts used in track-work, excepting fish-plate bolts, were greased with tallow before insertion, and all meeting surfaces of track timbers and other fixtures were given a thick coat of white-lead and oil paint before closing up.

III.—CURVES.

The general provisions concerning straight lines governed track-work on curves as far as they were applicable. The yellow pine ties were usually 10 ft. (3.048) long. To give the proper elevation of the outer rail, white oak bevel caps were used for the support of rails and guard timbers. The outer rail was elevated 3 in. (.0762 m.) calculated for a speed of ten miles per hour only; the elevation being gained in a distance of about 80 ft. (24.4 m.) on the tangent to the curve. The track-rails were curved by templets furnished by the engineer, true to line; no springing or sledging of rails was allowed. On curves with radii of 600 ft. (183 m.) and upwards each rail is held by three spikes per tie—two outside and one inside. On curves of less than 600 ft. (183 m.) radius, a steel guard rail was spiked down inside of the inner track rail; it was found necessary to plane off the flanges of this rail ¾ in. (.0191 m.) to permit the insertion of the screw bolts, or lagscrews; then steel guard rails were further supported and held upright in place against lateral shocks by white oak distance blocks, moulded to fit their sides, and extended nearly to the opposite guard timber, where they were "set up" by means of a wedge of oak; they were then bolted fast through the bevel blocks and cross-ties. On top of these distance blocks were bolted through cross-tie a white oak curved cap 3¾ in. × 10 in. (.0963 m. × .254 m.) section, partly covering the head of the steel guard rail; the inner face being 3½ in. (.08 9 m.) from the gauge side of the inner track rail. This was also guarded on the upper edge facing the track rail by a 5 in. × 3 in. (.127 m. × .0762 m.) angle bar secured by blunt bolts. These angles were in about 14 ft. (4.27 m.) lengths shaped to the curve with half check joints. The three remaining ranges of guard timbers for each track were composed of two white oak timbers, each 5 in. × 8 in. (.127 m. × .2032 m.) section clamped together sideways by bolts and lag screws, at intervals of about 1 ft. (.305 m.) They were then fastened to the cross-ties as on straight lines. Both ranges of guard timbers for the outside rails on curves were faced with strap iron, the timbers being spaced 6½ in. (.165 m.) from the gauge side of the track rail instead of 6 in. (.1524 m.) as on tangents. The ends of the cross-ties were then sawed off true to the curve. Figs. 1 and 2 of Fig. 9, represent sections of the track for tangents and sharp curves. Owing to the fact of longitudinal girders on sharp curves being chords of the arc, and the consequent means of fastening the cross-ties varied, the different sections are more or less dissimilar.

It may be of interest to know the organization which was maintained during the construction of this novel and somewhat exceptional class of track-work. As the work was necessarily continuous, or was deemed best to be so, it was found that the most economical daily force employed should not exceed seventy men, distributed over a space of about half a mile, as follows:

15 carpenters.
10 skilled laborers to assist the same on guard timbers.
10 men laying steel rails.
10 " clipping cross ties.
10 " spacing, marking and adzing cross ties.
10 unskilled laborers for derricks, distributing materials, etc.
2 horses with drivers.
3 foremen.

The clippers were usually kept about 500 feet (152.4 m.) ahead of the spikers, and the spikers 750 feet (228.6 m.) ahead of the carpenters on the guard timbers. Horse power was found to be cheaper and of more practical utility than steam in hoisting track material. The cross-ties were first hoisted, distributed and spaced; then marked for camber by means of T sights, adzed and clipped. Then the steel rails were in turn distributed, lined up and spiked; then the guard timbers were distributed, ends jointed, gauged and bolted down; the inside guard being put in place and finished with strap iron before the outside one was laid. A space of about 250 feet (76 m.) intervened between the gangs employed on the two ranges of guard timbers. Everything working smoothly, the above force accomplished about one block or 260 feet (79.25 m.) of double track *per diem* of ten hours, on tangent work.

The following statement gives the actual cost to contractors Quinn and Flynn of laying complete one thousand lineal feet (304.8 m) of straight single track:

Hoisting and distributing materials	$40.00
Laying cross ties	65.00
Hoisting steel rails	30.00
Hoisting guard timbers	100.00
Strap ironing guard timbers	20.00
Incidentals, loss of time, repairing tools, etc.	25.00
Superintendence	20.00
	$300.00
Amount paid contractor as per prices bid	350.00
Profit	$50.00

or 16⅔ per cent.

The amount of materials required for the construction of one thousand ft. (304.8 m) of single track, is as follows:

250 cross-ties, 6"×6"×12' (.1524 m.×.1524 m.×3.658 m.).
500 " 6"×6"×8' (.1524 m.×.1524 m.×2.438 m.).
3,000 wrought iron clips 5½"×2½"×½" (.1397m.×.0635 m.×.0127 m.)
1,500 lag screws, 6"×¾" (.1524 m.×.0191 m.).
67 steel rails, 30' (9.144 m.) long.
67 fish plates, 20"×2½"×¾" (.5032 m.×.0635m.×.0191 m.).
268 " " bolts, 4"×¾" (.1016 m.×.0191 m.) with nuts and washers.
3,000 spikes.
7,000 lineal ft. guard timber, 6"×8" (.1524 m.×.2032 m.).
1,500 guard rail bolts, nuts and washers, 14½"×¾" (.3684 m.×.0191 m.).
150 lag screws, 12"×¾" (.305 m.×.0191 m.).
2,000 lineal ft. strap-iron, 3½"×½" (.088 m.×.0127 m.) section.
300 strap iron bolts, 6½×½" (.1651 m.×.0127 m.) with nuts and washers.
300 blunt bolts for strap-iron, 5"×½" (.127 m.×.0127 m.).
¾ barrel Portland Cement.

TURNOUTS AND CROSSINGS.

To lay one typical crossing, consisting of 218 lineal feet (66.5 m.) of track, with five frogs, from switches and outside guard timbers, with inside steel guard rails, costs as follows:

Hoisting, adzing and clipping cross-ties	$18.25
Laying rails, frogs and switches	40.00
" guard timbers	12.50
" steel guard rails	4.25
Total	$75.00
Amount paid contractor as per prices bid	139.30
Profit	$64.30

or 85 7-10 per cent.

SIDEWALKS THREE PLANKS WIDE.

Cost to contractor per 1,000 lineal ft. (304.8 m.)	$15.00
Amount paid contractor as per prices bid	25.00
Profit	$10.00

or 66⅔ per cent.

PAINTING.

In mixing paints for iron surfaces, it is of the first importance that the best materials only be used. Linseed oil is the best medium, when free from admixture with turpentine; the latter being a volatile oil, cannot be used with advantage on a non-absorbent surface. Linseed oil, however, is peculiarly well adapted for this purpose. It does not evaporate in any perceptible degree. The large percentage of linolein which it contains combines with the oxygen of the atmosphere, and

(Continued on page 370.)

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

JOINT SESSION OF ENGINEERING SOCIETIES.

There will be a joint session of the American Institute of Mining Engineers with the American Society of Civil Engineers and the American Society of Mechanical Engineers at the Turf Club (formerly Union League) Theatre, corner of Madison avenue and Twenty-sixth street, New York, on Wednesday evening, Nov. 1, at 8 o'clock, for the purpose of hearing the memorial address on the life and works of the late Alexander Lyman Holley, to be delivered by R. W. Raymond, Ph. D.

AT the meeting of the American Public Health Association, at Indianapolis, on the 18th, Dr. T. P. Wilson, of Ann Arbor, read a paper on "Life on Wheels," estimating that there were constantly a million and a half people travelling on railroads besides those employed on the lines. He was convinced that more attention should be given to the hygienic needs of railroad travellers. Erastus Brooks, of New York, described the Board of Health system of New York State.

THE tenth annual meeting of the American Public Health Association is in session this week at Indianapolis, Ind. Meetings were held the 17th, 18th, 19th and 20th inst. Papers were read upon "Sanitary Associations," "Heredity," "Disease in the White and Black Races," "Sanitary Organization," "The Progress of Sanitary Science," "The Contagious Character of Tuberculous Consumption," "Sewers," "Cattle Disease," "The Disposal of Sewage," "Vaccination and Criminal Vaccination," "Smallpox," etc.; reports of committees, etc. The President for 1881–82 of the Association was Prof. R. C. Kedzie, of Lansing, Mich.

THE Grand Jury of Monmouth County, N. J., have been "making things hot" on sanitary infringements in that vicinity. For publishing articles alleging that typhoid fever was epidemic in Red Bank, the proprietor of the *Register* of that place has been indicted and bound over for trial; Jas. N. Corey, the belligerent proprietor of the fever-infected Hotel Bellevue, at Seabright, has to answer to five indictments, and charges are presented against several of the hotel owners and other property holders at Seabright for polluting the South Shrewsbury River with sewage. The Board of Commissioners of Long Branch and Asbury Park, the Ocean Grove Camp-meeting Association, and the Ocean Beach Land Association, are also censured for allowing offensive substances to pollute bodies of water within their jurisdiction.

It is time to adopt active measures for the protection of residents at summer resorts. A few years ago the need was not appreciable, but now that these resorts are so crowded in the warm season, it is an absolute necessity to provide suitable sanitary provision for the safety of those who pay the extravagant prices that are exacted at summer hotels and boarding houses. From the White Mountain region even, where malaria never claimed a residence, reports now come of its arrival with the ever swelling number of visitors, who for a while each year seek comfort, health and amusement amid its hills.

WE want statistics of the water-works of the following cities of 10,000 inhabitants, and will furnish blanks to any person who will be so kind and accommodating as to fill them out, and otherwise assist us in the matter:

Biddeford, Me.
Brockton, Mass.
Burlington, Vt
Canton, O.
Chattanooga, Tenn.
Cohoes, N. Y
Columbus, S. C.
Davenport, Ia
Dover, N. H.
Easton, Pa.
Evansville Ind.
Galveston, Tex.
Haverhill, Mass.
Hyde Park, Ill.
Joliet, Ill.
La Crosse, Wis.
Lewiston, Me.
Little Rock, Ark
Los An ●● , Cal.
Mobile, Ala.
Muskegon, Mich.
Portland, Or.
Pottsville, Pa.
Rock Island, Ill.
Rutland, Vt.
Sacramento, Cal
Saginaw, Mich.
San Antonio, Tex.
San Jose, Cal.
Shenandoah, Pa.
Springfield, Ill.
Stamford, Conn.
Stockton, Cal.
Steubenville, O.
St. Joseph, Mo.
Wheeling W. Va.
Youngstown, O.

If water-works officials would for a moment realize what relief we are endeavoring to bring them in a complete "History and Statistics of American Water-works," they would certainly hasten to send us all the information they possess. Once this volume is ready for distribution, a printed postal card, referring all inquirers after statistics to the recognized Encyclopedia, is all that will be necessary. An era of rest for circular-besieged superintendents is dawning, and we claim their co-operation in trying to save themselves. One more circular, properly filled out, and their labors as statisticians are nearly ended, and we will, single-handed, undertake to do all that the 600 and more cannot now do.

THE FEE OF THE STREETS.

Mr. Rufus Story, a coffee and spice merchant at Nos. 7 and 9 Front street, of this city, has at last brought the Grand Moguls of the Elevated Railway to something in the nature of "terms." From March to November, 1877, he had the New York Elevated Railway Company enjoined from making excavations in front of his property, for the purpose of building their railway. Judge Robinson, in the Court of Common Pleas, then dismissed the case, dissolved the injunction and left Mr. Story $1,333 out of pocket for costs and disbursements. Mr. Story carried the case to the Court of Appeals, and on Tuesday scored a victory over his opponents.

The case was re-argued before this Court of last resort on the broad question involving the right of the property-owner to an easement in a public street that entitles him to have it maintained as a public street, or recover damages to the extent of the actual injury to the property by reason of its use for an elevated railway. This important point was decided by a majority of the Court, and it establishes the rule of law that guarantees to property-owners compensation for injuries to property by the construction of an elevated railway. It means, stripped of all legal verbiage, that the construction of an elevated railway on a public street of New York will entitle any property-owner to damages to the extent that the property is actually lessened in market value by reason of the railway; and the broad ground on which the principle is decided, would seem to make the same legal rule applicable to other cities.

The case naturally excites a great deal of interest, and is commented on by all the leading journals of this and the other large cities of the Union. A new trial is ordered for condemnation purposes.

The opinion in full is as follows:

First—That the plaintiff, by force of the grant of the City to his grantors, has a right or privilege in Front street which entitles him to have the same kept open and continued as a public street for the benefit of his abutting property.

Second—That this right or privilege constitutes an easement in the bed of the street which attaches to the abutting property of the plaintiff and constitutes private property within the meaning of the Constitution, of which he cannot be deprived without compensation.

Third—That such a structure as the Court found the defendant was about to erect in Front street, and which it has since erected, is inconsistent with the use of Front street as a public street.

Fourth—That the plaintiff's property has been taken and appropriated by the defendant for public use without compensation being made therefor.

Fifth—That the defendant's acts are unlawful, and as the structure is permanent in its character, and if suffered to continue will inflict a permanent and continuing injury upon the plaintiff, he has the right to restrain the erection and continuance of the road by injunction.

Sixth—That the statutes under which the defendant is organized authorize it to acquire such property as may be necessary for its construction and operation by the exercise of the right of eminent domain.

Seventh—In view of the serious consequences to the defendant, we think no injunction prohibiting the continuance or operation of the road in Front street should be issued until the defendant has had a reasonable time after this decision to acquire the plaintiff's property by agreement or by proceedings to condemn the same.

Mr. John E. Parsons and William M. Evarts argued the case for the appellant, Story, and David Dudley Field for the Elevated Railway Company, respondent. Judge Tracy delivered the opinion. The opinion in full is published in the N. Y. *Times* of the 18th; the adverse opinion of the minority judges is published in the N. Y. *World* of the 19th. Both combined are of great interest and value on account of the legal information respecting the fee of streets embodied therein.

President Jay Gould, of the Manhattan Company, said to a reporter of the *World*: "The decision cannot affect the Manhattan Elevated Railway Company, since by a covenant in the leases it was expressly stipulated that the Manhattan Company should not assume the payment of such damages. The New York Company is protected by its agreement with the city, contained in the original charter, by which it was stipulated that the company should pay to the city 5 per cent. of its net earnings annually. The Metropolitan Company has no such grounds of defense, and the decision may result in closing the Fifty-third street branch, but even then all travel from Harlem could could down town by the Ninth avenue line direct."

Vice-President Gallaway said also: "The decision may result in the necessity of closing the branch of the Metropolitan along Fifty-third street, and so shut off the Harlem connection."

"In that event could you not extend the line from Fifty-eighth street to tap the line to Harlem?"

"Unfortunately that is what might be called an 'engineering impossibility,' on account of the lay of the land, even if we could get the right of way. The engineers, in running the survey to Harlem, ascertained that Fifty-third street was the first street coming down that could be utilized for the connection. At any point above that the grade would be so steep that the road could not be run."

THE INDUSTRIAL OUTLOOK.

The situation of the iron market is less favorable than a month ago. The western mills and furnaces are producing to their maximum capacity, but buyers are coming forward with considerable caution, born of the belief, or apprehension, that the resumption of iron making in so many mills and furnaces is destined to create an over supply and effect a corresponding reduction in prices. This seems to be the only plausible explanation of the quietness which characterizes the markets East and West after four months suspension in a large portion of the country. Another cause deserving of attention is that the crops, although very large and up to commercial expectations, are coming for-

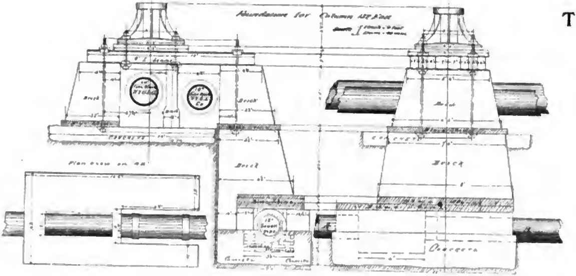


Fig. 5

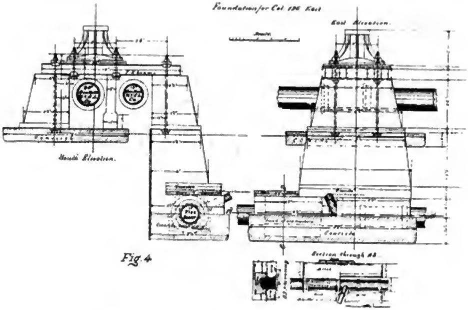
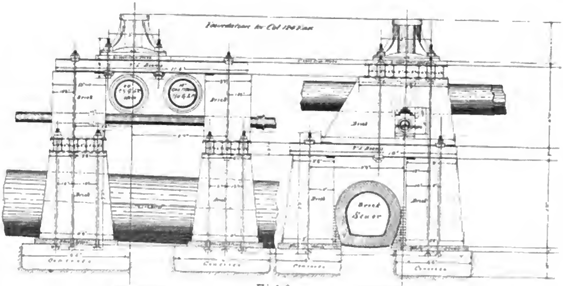


Fig. 4



South Elevation Fig. 3 East Elevation

THE METROP

BY THE L

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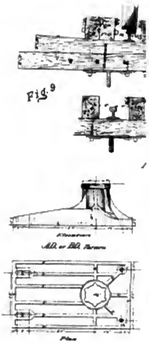
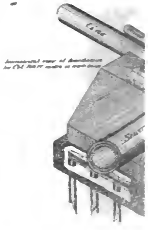




LITAN ELEVATED RAILROAD.

TE G. THOMAS HALL

. AM. SOC. C. E.

AD APRIL 20 1881.

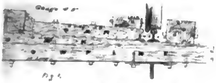


Fig. 4

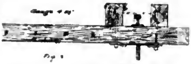


Fig. 5

atterns of Bases used on 2nd Ave line

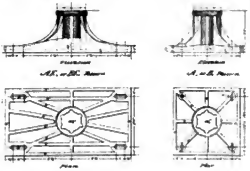


Fig. 7

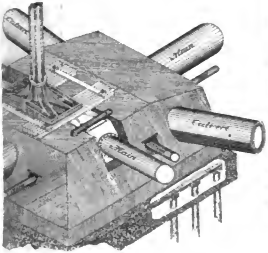
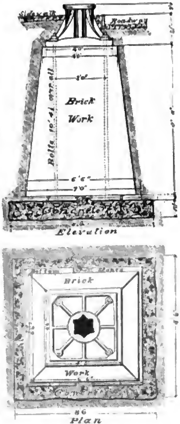


Fig. 6

Standard Sidewalk Pier

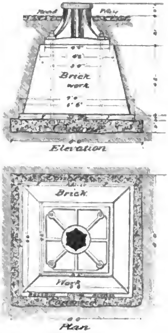


Elevation

Plan

Fig. 2

Standard Street Pier



Elevation

Plan

Fig. 1 .

Fender

Used on 2nd Ave.

Scale 1" = 1 foot

1 mm = 12 mm

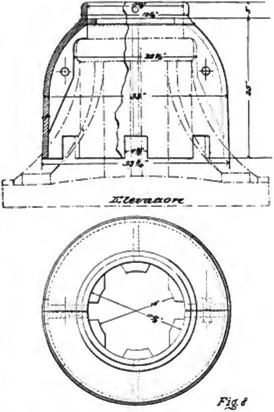


Fig. 8

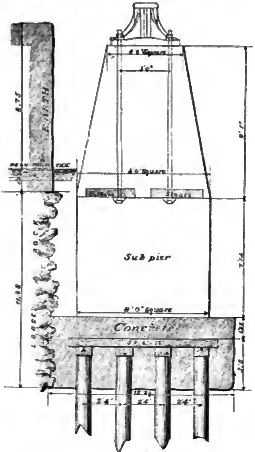


Fig 10

ward rather slowly. The reports of the Trunk line roads from Chicago eastward show that the shipments are considerably below those of last year, although improving every week. An active iron market will not be enjoyed until the crop movement assumes normal proportions, and consumers generally, in all lines of activity, present demands for their winter requirements. There is no reason why the industrial activity of the coming winter will not be greater than that of any former season. All the factors in the problem are favorable to it. Threatening storms of financial stringency have hovered over the horizon, but instead of having an unfavorable effect, they warned manufacturers, middle men and consumers that it is wisdom to go slowly and buy only what is needed and to let future requirements take care of themselves. At no time in our history perhaps was business conducted on a more legitimate basis. Furnaces and mills of course are sold ahead for a few weeks, but there is none of that wild anticipation of wants which characterized the trade a year ago. The reason is simply that the productive capacity of the country has increased to such dimensions that it is not necessary that buyers should buy three or six months ahead, assuming the risks of fluctuating prices in the mean time. Supply is equal to requirements, but it must be observed that there is a very rapid expansion of productive capacity in several directions, for instance, new rolling mills are going up, new blast furnaces are being projected and built, old furnaces are being repaired, and fresh appliances used to secure greater production. All these elements point to such a growth of production as in time will create an over production, which will lead to the necessity for restriction in some shape or other, unless requirements expand correspondingly, but even then the greater demand stimulates enterprise, and it is only a question of time when more iron and steel will be made than can be sold at a good profit. It will be perhaps a long time before the production will be so great as to destroy profits, but the industry is traveling in that direction. This fact is recognized by consumers and by projectors and investors, hence demand is limited to actual requirements. Bridges and roads can be built cheaper next year than this, and on this account there is none of that enterprise which in former years has been productive of disaster. The foreign situation is satisfactory. The workmen in the iron mills, following in the footsteps of their American brethren, demanded an advance, but fortunately selected a time when the employers had but one choice to make, and they made it wisely. The coal miners have requested a 15 per cent. advance, but will not discontinue work until November 1st, when it is said they will leave the mines unless their demands are complied with. American pig-iron is selling at $27 at furnace for standard brands of No. 1 Foundry, $21 to $25 for No. 2, and $22 to $23.50 for Grey Forge. Nearly all the furnaces are sold ahead up to December 1st. Very few buyers care to buy beyond this date. English Bessemer Pig is offered at $24, but American consumers will not pay over $23. The steel-rail mills are pretty well crowded with orders for the winter, the business of the past month aggregating 200,000 tons, which is about the full productive capacity. Large, round lots can be placed as low as $44, and it is probable that this will be the figure for 1883. It is said in some quarters that even lower prices will be reached. Capacity is being increased, and steel-rail makers recognize the necessity of adopting every device and expedient to reduce the cost of rails. A large number of new enterprises have been presented within a few weeks, covering not less than one thousand miles of road in the South, Southwest and far Northwest. The mileage constructed this year to date is 8,800 miles, and will, no doubt, reach 10,500 by the close of the year. Railroad dividends are in the main encouraging. The last returns of fifty-eight roads show four earned over 50 per cent., four over 25 per cent., and twenty-five over 25 per cent. But five of the entire number showed a decrease in earnings. The general condition of railroad interests is improving. The enormous crops promise an increase in traffic sooner or later, but the farmers at present are holding back their wheat for the sake of better prices. So far, Northwestern receipts show a decline of 25 per cent. for the season, and the Atlantic receipts show a decline of 58 per cent. The grand receipts of all kinds are 17½ per cent. less than last year to date, and 27 per cent. less than in 1880. The corn crop, which during 1880 and 1881 was over 1,700,000 bushels, will not reach 1,200,000 this year. As indicating the decline in cereal movements, Chicago's receipts for three months past were less than 34,000,000 bushels, as against 49,000,000 bushels for same time last year. These commercial indications are deserving of attention. Our industrial activity is dependent upon the volume of agricultural, mineral and manufactured products, and upon the profitable exchanges effected through the channels of commerce. Should no causes arise to arrest the spirit of enterprise or intimidate the large volume of capital waiting for a favorable opportunity, we can rest assured that the coming winter and spring will make a season of great undertakings, and the development of a number of enterprises which will furnish abundant employment to the millions of idle capital and to all of the labor and skill which America can command. While there are abundant evidences of prosperity about us, there are unfavorable indications which should be watched not only by business men and manufacturers, but by law makers. The spirit of speculation is waiting for opportunities to take advantage of circumstances and necessities. The great industrial interests have nothing to gain by speculation. It is one of those results and conditions which follow industrial enterprises like the hangers on of an army. There is abundant room for legitimate enterprise and for all capital which desires investment. The great South is opening up to Northern enterprise and most encouraging opportunities are being presented and accepted. Several lines of roads will be completed during the coming year, which will render accessible an enormous extent of country hitherto completely locked up. In the New England and Middle States manufacturers are finding an improving trade in providing for the requirements for machinery and for products for these sections. Nothing but bad management or excessive greed of speculators in stocks or conscienceless manipulators of values as represented in railroad bonds and stocks of various kinds can lead the industries to shipwreck or check our unprecedented growth of prosperity.

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OBITUARY.

Henrique Harris, Chief Engineer of the Long Island Railroad Company, died of diphtheria at his residence, 212 Adelphi street, Brooklyn, on the 10th inst. Mr. Harris was a native of Maracaibo, Venezuela, S. A., but nearly all his life was spent in the practice of his profession in this country. He graduated from Rensselaer Polytechnic Institute in the class of 1861. He was for many years an assistant engineer on the Parks and Water Works construction of Brooklyn, from which latter he resigned to accept the position of engineer of the New Brunswick, N. J., Sewerage and Street Departments, which position he resigned to accept charge of the engineering works of the Manhattan Beach Improvement Company. He was engineer for the sewerage of the Manhattan Beach and Oriental hotels, but would not allow his name to be associated with the sea-wall protection of these properties. He was, however, retained by Mr. Corbin as Chief Engineer of his Long Island Railroad system, and it was in his tireless devotion to the interests of this work, to the neglect of his personal health, that his sickness and death resulted. A neglected cold, a fatigued and over-worked mental and physical system, and the restless, nervous, excitable nature had to succumb to death. Mr. Harris was a brilliant man and an ardent lover of his profession, unusually well informed upon all subjects connected with it, scrupulously honest, an earnest and untiring worker, and, in his death, the engineering profession loses one of its most valuable men. He was rapidly rising to a prominent position, and all who knew him well found him a man of unusual ability. In his social life he was a most generous and courteous gentleman, and no man would do more to assist a friend. Mr. Robt. Van Buren, chief engineer of Brooklyn, his most intimate friend, took charge of him during his sickness, and will attend to all his affairs until his brother, who lives in Maracaibo, can be heard from. Mr. Harris was a member of the American Society of Civil Engineers, and a committee was appointed on Wednesday evening to prepare a memorial of his life.

PERSONAL.

Lyman Bridges, M. Am. Soc. C. E., of San Francisco, Cal., sailed for Europe in the City of Rome on the 14th.

Col. George E. Waring, Jr., Sanitary Engineer, will sail for Europe immediately on the completion of some special work on which he is now busily engaged at Pittsfield, Mass.

Mr. Charles A. Roberts of Fargo, Dak., has been appointed General Manager of the Sanborn, Cooperstown and Turtle Mountain Railroad, in addition to his duties as chief engineer of this new company.

Messrs. Rice, Bradley & Smith, general contractors, Billings, Montana, is the name of a new firm of "young men" who have "gone West" in quest of fortune. Geo. D. Rice, of the firm, was formerly Secretary of the Boston Society of Civil Engineers. The new firm will succeed, of course.

Mr. E. S. Chesbrough, Consulting Engineer of this city, sailed for Europe in the Alaska, of the Guion Line, on Tuesday, the 17th, to be absent about three months. Mr. Chesbrough's visit is to investigate some special features of European sewerage systems, and he will go as far East as Berlin and Vienna. He will also visit Spain before he returns, but not in connection with the particular objects of this trip.

Mr. George S. Morison, Chief Engineer of the Bismarck Bridge, has issued a number of invitations to engineers and others interested in bridge-building to be present at the testing of the completed bridge on this Saturday, the 21st. Free transportation is furnished by all the trunk lines running west from Chicago to St. Paul, from which latter city a special train on the N. P. R. R. conveys the guests to Bismarck. A reception and banquet by the business men of Bismarck will follow the bridge testing exercises.

Mr. G. W. Vaughn has resigned the position of chief engineer of the Chihuahua Division of the Mexican Central Railway, which has been built under his skillful supervision, and has accepted the position of chief engineer of the Mexican National Railway, Southern Division, with headquarters at the city of Mexico. He has started for that city, going from Laredo overland for the purpose of inspecting the route from Monterey to the City of Mexico, and of making observations as to the resources of the country. The Mexican National is to be congratulated on securing so able an engineer as Mr. Vaughn.

Northern Pacific Railroad.—The duties of the Inspector of Track, Bridges, and Buildings are extended to include a supervision of all the records of the Road Department on the several divisions in operation. He will be authorized to make such changes in said records and in the manner of keeping the accounts as will ensure uniformity, and furnish all the items of information required to fill the blanks in the forms prescribed for the annual reports. Division superintendents, roadmasters and other officers having charge of track, bridges or buildings will submit all books, records, and accounts having reference thereto to the examination of the Inspector, F. H. Lewis, and will make such additions or alterations thereto and such reports from time to time as he may direct. The Inspector will keep in his office such records as will furnish the General Manager at all times with full information in reference to the condition of the track, buildings and bridges on the several divisions, the number of laborers employed, the prices paid, the cost of all structures, the expenditures for repairs, maintenance, or betterment, the material on hand, and the amount and value of all purchased or consumed on each division.—H. HAUPT, General Manager.

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PROPOSALS RECEIVED FOR HARBOR WORK.

We are indebted to Mr. Stickney, of the firm of Carkin, Stickney & Cram, contractors, of East Saginaw, Mich., for the following list of bids for building cribs and dredging at the harbor of Grand Marais, Mich., opened at Milwaukee, on Sept. 23, 1882, for the United States government:

NAMES OF BIDDERS.	Pine timber.	Hemlock timber.	Plank per M. B. M.	Dr ft bolts.	Screw bolts.	Spikes.	Stone per cord, 128 cu. ft.	Dredging, per cu. yd.	Total amount.
	L. ft.	L. ft.	$	Ct.	Ct.	Ct	$	Ct.	$
Knapp & Gillan, Wis.	38	32	25	4¼	6¼	6	10.50	34	63,180.00
Green Bay Dredging & Pile Co., Wis.	33	33	20	5	6	5½	10.00	30	61,965.00
John H. Gillett, Mich.	30	29	18	4½	5	4	11.00	30	57,606.00
Chas. S. Barker, Mich.	32	32	18	4½	5¼	5	9.00	25	55,070.00
Carkin, Stickney & Cram, East Saginaw, Mich.	31½	30	20	4	6¼	7	9.50	32	56,185.00
Caul. F. McDougald, Minn.	33	32	20	7	7	7	12.00	30	70,000.00
Green Dredging Co., Chicago, Ill.	36	35	20	5	8	5	12.00	30	66,110.00

Awarded to Chas. S. Barker.

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PHILADELPHIA WATER.

Messrs. E. S. Chesbrough, J. Vaughan Merrick and Frederick Graff, the engineers selected by the Mayor to report to the Councils upon the water supply of Philadelphia, presented a partial report to the Common Council on the 19th. They find that in supplying lower levels of the city the existing machinery has been worked to its utmost capacity; that at the two largest steam works there is no spare machinery and in two others the whole supply depends upon one engine in each, and that at the present rate of annual increase in the consumption there will not be enough pumping power during the driest seasons of next year to sufficiently supply an area containing two-thirds of the population, while in 1884 there will be a short supply almost throughout the whole city. They regard the following-named machinery and appliances as imperatively needed for the supply of water to the city in the summer of 1883:

For the Schuylkill Works—Two 15,000,000-gallon engines, to pump, one against 150 ft. and one against a higher head, $96,000; two ranges of boilers and connections, $60,000; two forcing mains, $30,000; completing 48-in. main, partly laid, $14,000; boilers and engine house, $40,000; foundation for same, $10,000; total, $250,000.

For the Roxborough Works—One 7,500,000-gallon engine, to pump against 360 ft. head, with forcing main in house, $50,000; removing old and substituting two boilers and connections, $7,000; new inlet screen and dredging, $3,000; total, $60,000.

Distributing mains to supply Germantown from Mount Airy Reservoir to Manheim and Green, $70,000.

For the Frankford Works—One 10,000,000-gallon engine and connections, to pump against 200 ft., $45,000.

ESTIMATES OF THE COST.

The estimates given for the engines refer to the Worthington compound duplex, and they recommend cylindrical tubular boilers at the Roxborough works, and for the Schuylkill works marine tubular boilers.

"Your board," they continue, "are satisfied of the great importance of an early completion of the East Park Reservoir, of the need of a reservoir at Cambria and Thirtieth streets, and of increasing the size of the reservoir at Mount Airy. The appropriations for these reservoirs are next in importance to those for the machinery, for which estimates have been given. Expenditures under such appropriations would extend over a period of at least three years—1883 to 1885. Following are the estimates of the probable cost:

"East Park Reservoir and connections—completing two basins, $400,000; completing third basin, $300,000; forcing mains, $126,000; distributing mains, $371,200; total, $1,197,200.

"Cambria Reservoir and connections—Land, $100,000; 150,000,000 gallon reservoir, $375,000; forcing and connecting mains, $240,000; distributing mains, $105,000; total, $820,000.

"Mt. Airy Reservoir—Land, say $25,000 75,000,000 gallon reservoir, $225,000; total, $250,000."

These sums make a total of $2,267,200, of which the engineers say $647,500 should be expended in 1883, $765,000 in 1884 and $854,700 in 1885.

THE GRAVITY PROJECTS.

"In considering the question of present supply," the report continues, "it should be borne in mind that at least five years must elapse before a gravity system such as is contemplated by the Perkiomen and Delaware projects could be accomplished. At least one year would be spent in making surveys plans and detailed specifications. Their discussion and adoption would consume another year at least, and the construction of the works would take three or four years more. This is a sufficient reason for providing for an adequate water supply by steam pumping machinery and by storage in reservoirs up to 1888. Complete surveys must be made and reliable data obtained of the localities from which a pure water supply can be drawn. An appropriation of not less than $15,000 is suggested for such surveys.

"At each of the pumping stations there are now two engineers of equal authority, who are on duty alternately during the day and the night. Thus there can be no definite responsibility or uniformity of management." The board recommend that one superior engineer be placed in charge of each station. He should in all cases be responsible only to the head of the department. They consider the salaries now paid the engineers less than the pay of good mechanics in proportion to the time they are on duty, and far below what is paid in other cities for similar work.

MISCELLANEOUS SUGGESTIONS.

They also suggest that the several pumping stations and reservoirs should be connected together and with the Purveyors' and central office by telephonic communication. The board have been deeply impressed by the vital necessity of keeping out of the inlets to different pumping wells a large and constantly increasing amount of offensive sewage. They believe "that this great evil, so far as it proceeds from the sewer that empties into the Schuylkill River at the east end of Girard avenue bridge, can be abated at an early day and at a cost small in comparison with the importance of the object. This, however, belongs to the Survey Department of the city, which has also under consideration methods for keeping the sewage of Manayunk and the points below it out of the river above Fairmount dam."

Appended to the report is a table showing the pumping capacity and consumption for a number of years, and another table showing the organization and wages in different cities. In a marginal note the board say that if the large engine at Frankford breaks down there will be a short supply at Frankford, and if the larger engine at Roxborough or its boilers break down a failure at Germantown will be the result. The report was referred to the joint committee on water and finance.

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BRIDGE PROPOSALS RECEIVED.

The following is a list of the bids received for the Central Bridge, Lowell, Mass., Sept. 28, 1882. The bridge of 3 spans, 158 ft. 7 in., center to center of masonry. Roadway, 34 ft. Two sidewalks, 8 ft. in clear:

Name and Location.	Price.	Time from date of contract.	Remarks.
Morse Bridge Co., Youngstown, O.	$51,500	5 mos.	Manly & Cooper, Belmont, fence.
Penn Bridge Wks., Beaver Falls, Pa.	53,300	5 mos.	Own fence.
Wrought Iron Bridge Co., Canton, O.	58,853	4 mos.	Manly & Cooper, Belmont, fence.
Phœnixville Bridge Works, Phœnixville, Pa.	50,580	Feb. or March, '83.	Manly & Cooper, Belmont, fence.
Boston Bridge Works, Boston, Mass.	50,600	6 to 7 mos.	Own fence.
Corrugated Metal Co., East Berlin, Conn.:			
Plan A	60,070	May 10, '83	Pratt Truss, M. & C., Belmont, fence.
" B	61,820	do	do. do.
" C	64,224	do	do. do.
" D	64,026	do.	do. do.
" E	61,728	do.	Parabolic Truss, M. & C. Belmont, fence.
" F	62,220	do.	do. do.
D. H. & C. C. Morrison, Dayton, O.	63,700	6 mos.	Own fence.
King Bridge Co., Cleveland, O.	60,000	6 mos.	do. do.
Pittsburgh Bridge Co., Pittsburgh, Pa.	60,850	May 1, '83.	do. do.
Hilton Bridge Construction Co., Albany, N. Y.	55,000	Mar. 20, '83	do. do. Riveted bridge not called for.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The society met Wednesday, Oct. 18th, 1882, at 8 p. m., Vice President Wm. H. Paine in the chair, John Bogart, Secretary. The death of Henrique Harris, M. Am. Soc. C. E., on Oct. 10th, was announced and the preparation of a memoir was directed.

A paper by Henry D. Blunden, M. Am. Soc. C. E., on the *Care and Maintenance of Iron Bridges* was read by the Secretary. The writer observed that while many papers and much discussion had been published on the design and construction of Bridges, there had been little or nothing on the subject of their care and maintenance after erection. Indeed, there seems a prevalent idea that once erected they will last forever with no care but an occasional coat of paint, and even that is often not attended to. A close examination during nine years past of a large number of bridges shows constant, shameful neglect. The fact is that the immediate care of bridges is generally left to men who know nothing either practically or theoretically of their design or manufacture. The single idea is to screw everything up tight and to replace all rivets without asking why a rivet drops out several times in the same place. The paper enumerated various causes of undue wear in bridges; uneven bearing of rails and ties; insufficient freedom of expansion gear often caused by accumulation of dirt; improper anchoring of fixed ends; poor masonry; uneven adjustment of laterals; uneven bearing of suspended floors; over-tightening of counters; corrosion of iron; false economy in construction of floors rendering renewals very expensive; too large joints between ends of rails.

The writer also gives a number of suggestions as to the proper care of bridges, particularly insisting upon constant inspection and frequent reports to the office of the Chief Engineer.

The paper was discussed by Messrs. C. Macdonald, S. H. Shreve, Thos. Cooper, Wm. H. Paine, J. P. Davis, W. E. Worthen, J. G. Sanderson, C. E. Emery and J. C. Campbell. In the discussion the great necessity of attention to the care of bridges in use was forcibly brought out. Instances were mentioned of the serious results of intrusting this duty to incompetent men and of the advantage found by the few corporations now taking proper measures. Reference was made to the great difficulty of adjustment in bridges with parts in cast and parts in wrought iron. A case was described in which an iron rod in contact with sulphur became seriously corroded. It was stated that the ordinary commercial sulphur had an amount of sulphuric acid sufficient to cause rust, but that when properly washed it was safe. The use of sulphur or lead for joints was discussed. An ordinary misapprehension as to scale was illustrated by an instance when the actual amount of iron in the scale was found to be but one-tenth of the scale. The use of lime whitewash to protect iron was considered, and instances of its good effect were mentioned. Mr. J. C. Campbell mentioned a case where he uncovered 1,000 ft. of cast-iron water pipe and found it perfectly free from rust, it having been well whitewashed many years previously before laying. Mr. Jos. P. Davis inquired concerning the experience of members with paint for iron bridges where they were exposed to the action of locomotive smoke and steam. He had tried all kinds of paint on the Boston bridges, but had come back to red lead, which, however, was unsatisfactory.

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THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 356.)

CCLXXXVIII.—DALLAS, TEX.

Dallas, Texas, in lat. 32° 40′ N., long. 96° 45′ W., on Trinity River, is on a bluff 25 to 30 ft. above high water mark.

Settled in 1841, it was incorporated as a town in 1844.

Water-works were built by Travers Daniel, for a private company, in 1876, taking the supply from a well 32 by 80 ft., sunk in coarse gravel near the river. The well is connected with the river by 500 ft. of 12-in. iron pipe. The water is lifted 100 ft. into a plate iron stand-pipe 15 ft. in diameter and 55 ft. high, by two Knowles pumps of 80 H. P.

Distribution is by 10 miles of cast iron pipe of from 10 to 4 in. diameter, with 73 fire hydrants, 45 gates, and 500 taps. There are three meters in use. Service pipes are of wrought iron. The population in 1880 was 10,358. The daily consumption in 1881 was 145,000 gallons.

The works have been purchased by the city. They have cost $85,000, and the bonded debt is $70,000, at 6 per cent. interest. The total receipts have been $72,000. The expenses in 1881 were $5,000, and the receipts $12,000.

The works are managed by a board of three water commissioners chosen by the Common Council from their own number. The Superintendent is appointed by the Commissioners for 2 years. Henry A. Hiles was the Superintendent of the company to 1882. The office is now held by A. M. Wheless.

CCCLXXXIX—CARTHAGE, MO.

Carthage, Missouri, in lat. 37° 15' N., long. 94° 30' W., is on Spring River. Settled in 1866, it was incorporated as a city in 1872.

Water-works were built for a private company in 1881–2, by John M. Slaney, taking the supply from Spring River. The water is passed through a filter of stone and gravel 25 by 50 ft. and 12 ft. deep, and is pumped by a Knowles pump of 1½ million gallons daily capacity, to a height of 170 ft. into a stand-pipe of plate iron 8 ft. in diameter and 70 ft. high, on ground 70 ft. above the city. The ordinary pressure in the mains is 40 lbs. and the fire pressure 60 lbs.

Distribution is by 7 miles of cast-iron pipe of 10 to 4 in. diameter, with 50 fire hydrants and 6 gates. The number of taps is not given. The city pays $60 per year for each hydrant. Service pipes are of wrought iron.

The population in 1880 was 4,210.

The daily consumption in 1881 was 150,000 gallons.

The capital stock of the company is $60,000. The works have cost $63,000 and the bonded debt is $50,000.

The receipts in 1881 were $7,500.

David S. Thomas is the President and Superintendent, and C. L. Bartlett the Secretary and Treasurer.

(TO BE CONTINUED.)

WESTERN SOCIETY OF ENGINEERS.

The 155th regular meeting was held at 4 P. M. Oct. 3, in the rooms of the Society. Mr. Benezette Williams was called to the chair, and Mr. Liljencrantz was appointed to act as Secretary *pro tem.* The following gentlemen were elected members: Mr. John J. McVean, Chief Engineer Detroit, Lansing & Northern Railroad, and Mr. Charles S. Pease, U. S. Civil Assistant Engineer, Council Bluffs, Ia. Mr. D. J. Miller, Engineer of the Chicago City Railway Company, read a paper on "The Chicago Cable Roads." The paper was illustrated by a number of drawings, and was subsequently discussed by the members, among whom Mr. Wright, Engineer of the North Chicago City Railway, endeavored to demonstrate that the horse railway is equally cheap, furnishes as rapid transit, is less dangerous, and gives, all considered, as much general satisfaction, when compared with the cable road.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

MESSRS J. A. CLOUD & CO. have secured the contract for building water-works at Randolph, N. Y. The water is taken from Cold Spring, two miles from the town; gravity system; elevation of source of supply, 180 ft.

VOTED TO BUILD WATER WORKS.—The people of Bellefontaine, Ohio, at the last election voted in favor of building water-works at an estimated cost of $60,000. ——The gas-works are now owned by the city. The streets are all lighted out of the net earnings of the works and gas furnished to consumers at $1.50 per thousand feet.

NEW WATER-WORKS IN INDIANA.—The city of Jeffersonville is building water-works to cost $75,000 or $80,000. Grounds upon which to erect the stand pipe and engine-house have been purchased at Port Fulton, a suburb of Jeffersonville, and the pipes for the works are being delivered upon the streets of the city.

THE town of Swampscott, Mass., has voted to take water from Lynn, Mass., and has appropriated $5,000 for pipes. The Lynn Water Board offered to furnish water for fire purposes for $108 per year and to charge the Lynn rates for connections for domestic purposes.

PULLMAN, Ill., consumes about 800,000 gallons of water daily.

SOUTH ABINGTON TO HAVE A SUPPLY OF WATER.—ABINGTON, Mass., Oct. 13.—South Abington held a largely-attended meeting to-night, William P. Corthell, Moderator, the main issue being the consideration of the report of the com ο ttee chosen in regard to protection against fire and for a water supply. After nearly two hours' discussion it was voted that the following plan be adopted, not to exceed an expenditure of $50,000: To pump the water from Hobart Pond into an iron reservoir 30 ft. in diameter and 60 ft. high, on Tillson Hill, and to lay about seven miles of pipe to carry the water through the town for the Fire Department, family and manufacturing uses; to purchase three hose carts, 1,800 ft of hose, two Harkness extinguishers, village size, with three buildings for keeping the same. It was also voted that the present committee investigate in regard to all the legal bearings on the matter, and report at a future meeting.

THE MADISON CITY WATER-WORKS, which are being built after the plan of Chester B. Davis, and under his supervision, are approaching completion. The work was commenced about July 1st. The pipe laying was completed on the 3d inst., there being 12 miles in all, and it is now being tested. The building and machinery are nearly completed, and the regular supply for ordinary purposes will be commenced on or before Nov. 1st. The water supply is obtained by artesian well, 750 ft. deep, from the Potsdam sandstone, the water flowing naturally to a level about 3 ft. above Lake Mendota. The trial well, 5 in. diameter, was tested by pumping to a daily capacity of about 500,000 gallons per day. Two 8-in. wells are to be sunk to the same depth to complete the supply, and a pipe is to be run into the lake for fire purposes, when necessary to have more water than the wells will afford. The construction of the stand-pipe, which is to be 8 ft. in diameter and 175 ft. high, will be put off until next year. The total cost of the work done this year will be over $100,000.

MORE WATER FOR WASHINGTON, D. C.—The project submitted by Major Garrett J. Lydecker, Corps of Engineers, U. S. A., to the Chief of Engineers regarding the work of extending the Washington aqueduct as provided by the act of July 15, 1882, was forwarded by General Wright to the Secretary of War for his action, and was approved on Tuesday by Secretary Lincoln. Major Lydecker explains what has been done in the way of surveys, and suggests that a tunnel from the distributing reservoir to the proposed reservoir on the heights near Sixth street will accomplish the desired results in the most substantial manner at the least cost and the shortest time. He thinks there is no doubt that the tunnel can be made through solid rock in a direct line, and its construction would be a simple piece of engineering work. The tunnel will be 21,400 feet long, requiring about 66,350 cubic yards of excavation, at a probable cost of about $500,000. The total appropriation available under the bill is $1,472,979.30, of which $599,534 55 is for the extension of the aqueduct alone. A tunnel will be preferable to a surface conduit, as it avoids complicated engineering difficulties and extensive excavations. He recommends that the work be done by hired labor, but this is not approved by General Wright, and the question is left for future action. Trial shafts will be sunk by Major Lydecker to determine whether solid rock will be found along the whole line of the proposed tunnel. Plans for raising the Great Falls dam will be submitted hereafter.

IN your issue of Oct. 7, 1882, page 354, you give us credit for having contract for water-works at Lyons, Ohio. This is a mistake; we have a contract at Alliance Ohio.

Yours truly,
J. A. CLOUD & CO.,
15 Wall street, N. Y.

ELECTRICITY.

LIGHTING HELL GATE.—A note from Washington dated the 13th, says: At a regular meeting of the Lighthouse Board to-day, a report was received from the special committee on the lighting of Hell Gate by electricity, recommending Hallett's Point as the best available site for the electric light tower; also suggesting that the tower be constructed of iron, with a height of 250 ft., and to contain lights of 20,000 candle power to be displayed from sundown to sunrise. The report was adopted and it was ordered that the necessary plans and specifications for the tower and machinery be prepared at once. Proposals for the work will be advertised for as soon as the necessary papers can be prepared. It was also decided that all the machinery to be employed in this tower be duplicated, so that in case of accidents to any part of the machinery it can be immediately replaced.

THE LARGEST CABLE.—The cable which the Baltimore & Ohio Telegraph Company laid Sept. 26, across the Narrows at the entrance of New York Harbor is believed to be the largest cable made in this country. It contains seven conductors of No. 14 copper wire, insulated with kerite, and wound with galvanized iron wire. Its length is 6,500 ft., diameter 2¼ in., and weight 8,500 pounds. It was made by the Kerite Company, at Seymour, Connecticut. Telegraphic communication with the West and South has hitherto been through cables across the Hudson. The new connection is by wires across the East River Bridge, thence to Fort Hamilton, crossing the Narrows to Staten Island by the cable. A cable across the Kill von Kull will connect Staten Island with the mainland.

MOLINE, ILL., is talking of the electric light.

A NEW CABLE.—OTTAWA, Ont., Oct. 12.—Next summer the government will lay a cable under Lake Superior, connecting with the telegraph system of Ontario.

THE MIDLAND TELEPHONE CO. have established telephone exchange at Bellefontaine, O. About 100 subscribers at present and number steadily increasing. Connections have just been completed with Cincinnati, Dayton, Springfield, Xenia and other neighboring cities and towns.

STREETS, DRAINAGE, ETC.

WATERBURY SURVEY.—The sewer commissioners of Waterbury, Conn., procured plans for sewerage of the city from Eliot C. Clarke, C. E., of Boston, and Rudolph Hering, C. E., of Philadelphia. They preferred Mr. Hering's plan and recommended it for adoption. This plan, as appears from Mr. Hering's very lucid report, provides for the present discharge of the sewage into the Naugatuck and Mad rivers, with such an arrangement of the outfalls as will admit of the future interception of the sewage and its conveyance to grounds below the city adapted for purification by irrigation, when the volume of sewage shall have become sufficient to pollute the streams. The topography has been carefully studied by the engineer, with the result of recommending for economical reasons a partial separation of storm and sewage water in some localities and an entire carrying of storm water in others. As far as can be judged by a person not familiar with the localities, the reasoning in the report is sound and the conclusions justified by the reasoning. Some of the rain water can be carried off by natural channels, and it is sensibly advised that roof and yard water should be turned into the sewers and street water which carries dirt and detritus should be kept out of the sewers and put into the streams. The cost of the sewers, recommended to be constructed at once, is estimated by the commissioners at $73,330.

RIVERS AND HARBORS.

THE MISSISSIPPI LEVEES.—VICKSBURG, Miss., Oct. 16.—Work is about to be commenced on the broken levees between here and Memphis. Several contractors are in the city to-day, making large purchases of implements, and are preparing for active operations.

DAN KELHERR is employing twenty-eight men in building a wing dam in the Mississippi River, on government contract, five miles below Burlington, and at the same time he is furnishing rock for ice-breakers at the Chicago, Burlington & Quincy bridge at Burlington. The government contract amounts to $25,000.

RAILROADS.

A CERTIFICATE OF INCORPORATION REFUSED.—BOSTON, Oct 13.—The Board of Railroad Commissioners has refused the application of the New York & Boston Inland Railroad Company for a certificate of incorporation because the capital stock has not been subscribed for by responsible persons.

THE project of the Cincinnati, Green River & Nashville Railway Company, to construct a railroad from King's Mountain, on the Cincinnati Southern, to Nashville, on the line that was surveyed and partially graded for the Cumberland & Ohio road, is taking shape, and it is expected that active operations will be begun within the next thirty days.

THE AUSTIN, MANKATO & ST. CLOUD RAILROAD.—The Austin *Transcript* gives the terms of the contract for building the Austin, Mankato & St. Cloud Railroad: "The New York Construction Company is to build the entire line of about 190 miles, between the Iowa State Line and St. Cloud, within two years from Dec. 15, 1882. The only conditions are that bonuses equal to $1,000 per mile, in the aggregate, shall be voted—or in other words, the company expect $200,000 in bonds for the entire line. The company will ask of the city of Austin $29,000, and it is expected our citizens will have a chance to vote the bonds on general election day. Propositions and papers are being prepared by Director Page, and the proper notices which the law requires will soon be posted."

WILL ISSUE $1,100,000 BONDS.—A note from Philadelphia dated the 17th, says: A proposition to issue $1,100,000 bonds was adopted at a meeting of stockholders of the Susquehanna & Delaware River Railroad to-day. It is also proposed to build a line 200 miles long from Harrisburg to the Delaware at Portland or Belvidere. R. B. Osborne, the engineer of the railroad, read a report in relation to the section between Slatington and Kettaliar Station on the Lehigh & Lackawanna branch of the Central Railroad of New Jersey, a distance of thirteen miles. It is stated that the building of the road met with warm encouragement from the owners of slate quarries, and that the President of the Lehigh & Susquehanna Railroad had given one of the engineers of the Susquehanna & Delaware River Railroad to understand that, in the event of competition with the latter road, his company would make a traffic contract with it.

PROGRESS OF THE CANADA PACIFIC.—W. C. Van Horne, general manager of the Canadian Pacific Railroad, says there is about 1,300 miles of that road completed, and there is yet 2,850 miles to be laid. The work is advancing three and a quarter miles per day on the main line west, and from one and a half to two miles per day on the branches. There will be 860 miles of branch road in operation this fall. To do the work of construction and to operate the line requires the help of 10,000 men. Of the force 5,300 are in the direct employment of the road, and the others are under contract. The pay of the laborers working for the road is $2 per day. Those employed by the contractors receive $2.25 per day. This force will be kept at work until Nov. 1. There has been no sickness among the men this season and all are young and hearty. A part of the laborers will probably go south this winter. The company has a contract with a number of them to return them to the boundary line free of cost.—*Exchange.*

THE MISSISSIPPI VALLEY R. R.—A special from Vicksburg, Miss., says: "Work on the Mississippi Valley Railroad south and north of here is progressing rapidly. The contractors have a force of 500 men and 90 teams working the cut through the dividing ridge between the Big Black River and Bayou Pierre. A construction train is now laying steel rails south of the Big Black River. Two engineer parties are locating the line between Baton Rouge and Port Gibson, working from each point, and the contract for the construction of this section will be let as soon as the line is located. North of Vicksburg 30 miles of the road-bed has been completed, and a large force is at work constructing a bridge over the Yazoo River."

THE Nebraska, Topeka, Iola and Memphis Railway Company has been reorganized and the following officers chosen: President, A. G. Clarke, of Chicago; Vice-President, H. M. Clarke, of Chicago; Secretary, General A. Bowens, of Iola, Kan.; General Solicitor, J. H. Richards, of Iola, Kan.; Directors—T. W. Giles, E. C. Deveraux, A. S. Johnson, Topeka; C. H. Martin, Girard, Kan.; B. E. Clarke, W. H. Clarke, S. W. Ransom, of Chicago, and all the officers named above. A contract was let to B. E. Clarke & Co., of Chicago, to build 100 miles of the road from Iola to Topeka, which will complete the line from Girard here. The work of construction, it is said, is to commence at once, and will be pushed vigorously, with the expectation of having the road completed to Topeka by October 1, 1883.

PROGRESS IN MEXICO.—We have received items as follows from the City of Mexico: Several works of public improvement were formally begun in this city and in the interior on the 16th.——The railroad from Puebla to San Martín, Texmelucan, was opened to traffic amid the great rejoicing of the people of the adjacent country.——Traffic was begun on the Mexican Central Railway from El Paso through to Chihuahua, and the line on the Merida and Calkini Railroad was opened as far as the "hacienda," of Chansinkin, and on the same day work was begun on the construction of a street railroad in San Juan del Rio.——The railway progress here at present is remarkable.——A telegram received lately announces that the Altata Railroad will be completed to Culiacan by the 16th of next month.——It is stated that the railroad from Campeche to Lerma will also be completed by the end of October.——Work is being pushed with great energy on the National Interoceanic Railroad—the narrow-gauge line to connect this city with Alvarado on the Gulf and Acapulco on the Pacific. An excursion party composed of 400 persons celebrated lately the completion of the Mexican National Railroad to Monterey by making a trip to Nuevo Laredo.——The following work is reported on the Irolo Railroad, which is ultimately to extend through the State of Puebla and form connections that will constitute a new line to Vera Cruz: 21 kilometers from this city to Reyes, 21 kilometers from Reyes to Texcoco and 18 kilometers from Texcoco to Irolo completed; 15 kilometers are also completed beyond Irolo, and work is active on the next 5 kilometers. The line from Irolo to Tepetlaxtoc is also under construction.——The Department of Public Works has extended the time for making the surveys of the railroad from San Luis Potosi to Aguascalientes six months. On the railroad from Tampico to San Luis Potosi 165 kilometers of line have been located, 95 kilometers cleared of undergrowth and 48 kilometers completed.——There is much activity displayed on the Guanajuato branch of the Mexican Central, and it is expected that it will be opened for traffic about the 20th of next month.——A train conveying Messrs. Hinchman, Buchanan and Ibarrola went out on the Mexican National Railroad on the 13th as far as Puerto Medina, 126 kilometers from this city. An immense crowd, composed of the residents of the surrounding towns, had assembled to greet the arrival of the train, and great enthusiasm was manifested. The citizens of Tlapujahua presented a Mexican flag to the company: bearing the following inscriptions. On the green stripe, "Viva el progreso;" on the white: "Tlapujahua and vicinity congratulate the company on reaching Puerto de Medina with their engine," and on the red: "Tlapujahua, district of Maravatio, to the Company Sullivan, in honor of its railroad progress. September 13, 1882." The road is reported to be solidly built and in good condition.——The regulations proposed by the government for the management of railroads have become a matter of deep interest to these enterprises. The code, which contains no less than 891 articles, deals with almost everything that concerns a railroad, from the right of way to the issue of baggage checks. They say that the rules are based on those enforced by a French company, which framed them for the guidance of its own staff, not caring whether they were adapted for use elsewhere.

THE ST. PAUL, EASTERN & GRAND TRUNK RAILWAY.—At the annual meeting of the St. Paul, Eastern and Grand Trunk Railway, held in Chippewa Falls, Wis., the reports of the President and Superintendent were submitted. Twenty miles are in progress of construction, and the first ten miles from Oconto, a connection with the Wisconsin & Michigan road, is ready for the rail. President Pound reported the purchase and shipments of the first 1,000 tons of rail and all material for construction. Track-laying will commence about the 20th. A new board of directors was elected.

THE FOREST CITY SOUTHERN RAILWAY OF IOWA has changed its name to Chicago, Iowa & Dakota Railway Company. The road is now being built from Gifford, in Harden County, to Forest City, in Winnebago County, eighty miles. Track is already laid to Eldora.

PASSENGER TRAFFIC.—It is held by well-informed railroad men that more people are handled daily at the Kansas City Union depot than at any other in America, and the caterer's rent, which has been in the neighborhood of $6,500 per year, has been raised to $20,000.

A CABLE ROAD.—There is a pending offer to construct a cable line for street cars in Columbus, Ind., provided the city will grant a satisfactory charter.

PROGRESS ON THE OREGON SHORT LINE.—The main line of the Oregon Short Line is now built 28 miles from the falls of Snake River, and is within 65 miles of Junction City. Owing to the scarcity of ties the main line will not be able to reach the junction this year, and probably will not build much farther than they now are. From the junction to the falls the distance is 92 miles, and the road is almost an air line. The grading is nearly completed to the junction, and between there and Little Wood River on the branch road considerable work has been done, with the exception of about three miles. The bridge over Little Wood River is very nearly completed, and a great amount of heavy work has been done, in fact, more than could reasonably be expected, owing to the nature of the country.

ROAD COMPLETED.—On Monday last the final spike was driven and the last rail was laid on the Leavenworth, Topeka & Southwestern Railway, on its line between Leavenworth and Meridan, where connections are made with the main line of the Atchison, Topeka & Santa Fe road. With the completion of the new line Leavenworth is just 12 miles nearer Topeka by rail than heretofore, the distance by Lawrence being 69 miles, while by the new line it is only 57 miles.

PRICES OF STEEL RAILS IN EUROPE.—From the *Ironmonger* of London we take the following: The following tenders were recently sent in to the Roumanian Minister of Public Works for the supply of 16,500 tons of steel rails: Bolckow, Vaughan & Co., Eston, 159f. 37c. per ton; Cockerill, Belgium, 162f. 55c.; Bochum Verein, Germany, 162f. 48c.; Gute Hoffnungs Hutte, Germany, 183f. 90c.; Krupp, Germany, 174f. 60c.; Aron Hirsch, Austria, 185f.; Moss Bay Hematite Iron, &c., Company, 173f. 50c.; Union Dortmund, 162f. 60c. Bolckow, Vaughan & Co.'s tender was thus distinctly below those of the other competitors, and the *Curieral Financiar*, in noting the tenders, adds that not only are the English rails the cheapest, but that in quality also they surpass those of any other country.

TUNNELS.

HUDSON RIVER TUNNEL.—Work on the Hudson River Tunnel is being steadily pushed forward, and by Nov. 1 the large air compressor now building for the tunnel by the Clayton Steam Pump Works of Brooklyn, N. Y. (three of whose compressors have been used since the commencement of the tunnel), will be placed in position and working. This air compressor is of the Clayton Improved Duplex pattern, having two 22-in. diameter steam cylinders, two 24-in. diameter air cylinders and 30 in. stroke. It is 20 ft. in length, 10 ft. in width; weighs 25 tons; and its working capacity is 3,750,000 cubic feet of air per 24 hours.

CANALS.

THE French engineer, M. Laurent, has received the permission of the Austrian government to make a canal joining the small Galician River, the Sau, with the Dniester, which will complete the water communication between Dantzig and Odessa. The undertaking is a private enterprise.

BRIDGES.

RAILROAD BRIDGE REBUILT.—The Mexican National Railroad Company completed the reconstruction of its bridge across the Rio Grande at Laredo on the 11th, thus restoring rail communication between the republics, which was broken a few weeks ago by high water. The bridge has 20 spans, each 80 ft. long. The International & Great Northern road, whose bridge was also swept away by the same freshet, has not yet begun to rebuild.

BRIDGES FINISHED.—The 6 of the 11 new bridges the Cincinnati, Indianapolis, St. Louis & Chicago Company is building between Sunman and Lawrenceburgh Junction, have been completed.

BUILDING.

THE NEW HEAD-QUARTERS of the Baltimore & Ohio at the corner of Baltimore and Calvert streets, in Baltimore, will be occupied next month. The ground is the most costly of any of its area in Baltimore, but its central location warranted the expenditure. The building has a frontage of 102 ft. 6 in. on Baltimore street and 104 ft. 4 in. on Calvert street, and is without doubt one of the finest structures for its purpose in the world. The road, by the way, has just made a semi-annual dividend of 5 per cent. on the stock of its main stem and Washington branch.

NO BIDS RECEIVED.—The Police Commissioners of this city obtained an appropriation of $60,000 to build a new police station and advertised for bids, but none were received as it was thought the foundations alone would consume the entire amount. The Board now asks for $40,000 additional.

PLATTEVILLE, WIS., is to have a new city hall.

CONTRACTS LET.

JAY GOULD'S NEW YACHT.—PHILADELPHIA, Oct. 18. The contract for building a steam yacht for Jay Gould was this afternoon awarded to Cramp & Sons, of this city. It will be constructed of iron and steel, and will have steel boilers. It will be 210 ft. long, 27 ft. beam, and 16 ft. deep, and will have 1,500 indicated horse-power. The vessel will be ready for sea early in the spring.

STONE CONTRACT COMPLETED.—A contract is now being completed at the Montello, Wis., quarry for $100,000 worth of stone for Chicago parties to be used for paving the streets. The stone is got out in pieces ten inches long and about five inches square, twenty five of them making a square yard when laid. The expense of this block delivered at Chicago is about $4.25 per yard.

CAR CONTRACT MADE.—Mr. C. C. Waite, Vice-President and General Manager of the Cincinnati, Hamilton & Dayton, has contracted with the Terre Haute Car Works for 100 new flat cars.

GOVERNMENT CONTRACT LET.—Bids were opened in the office of the Supervising Architect of the Treasury on the 12th, for iron railings for approaches at the post-office and court-house building and for floor lights at Philadelphia as follows: Samuel J. Creswell, $5,512.80; Manley & Cooper, $5,940; Bartlett, Hayward & Co., $6,065; J. S. Stevens, $5,995; J. S. Thorn, $5,700; Phœnix Iron Company, $5,854. The contract will be awarded to Samuel J. Creswell.

At the last meeting of the trustees of Hyde Park, Ills., the superintendent of public works was instructed to prepare plans for a bridge across the Calumet River at Ninety-second street. Bids for finishing the water-works tunnel were opened. They ranged from $52,000 to $69,000. Dolese & Shepard were awarded the contract for grading and macadamizing South-Chicago avenue from Stony Island avenue to South Park avenue for $31,090.

MISCELLANEOUS.

Leadville now produces one-third of the lead made in the United States.

Twenty years ago it required five tons of coal to make a ton of iron rails. Now a ton of steel rail may be produced from the ore with half that amount of coal.

New York doctors have declared against flats and apartment houses on the ground of health.

Many prominent New York society ladies are ill of malaria contracted at summer resorts.

ON THE CONSTRUCTION OF THE SECOND AVENUE LINE OF THE METROPOLITAN ELEVATED RAILWAY OF NEW YORK.

(Concluded from page 365.)

makes the surface of the paint solid and of resinous appearance, possessing toughness and elasticity. Linseed oil does not crack or blister, by reason of the expansion and contraction of the iron with variation of temperature. Another important characteristic is its expansion while drying, which peculiarly adapts it to iron surfaces. The Metropolitan Elevated Railway Company spent no small amount of money in experimenting with various classes, kinds and colors of paint, before arriving at a final conclusion; their labors at last culminated in the selection of a metallic paint for the first coat, and a white lead paint for the second and last coat, both paints to be mixed with the best boiled linseed oil, and enough turpentine to make the paint cover well and facilitate its drying. The following formulæ were therefore adopted and adhered to:

(1.) METALLIC PAINT.
9 parts of boiled linseed oil.
1 part of turpentine.
7½ pounds of "metallic" (ground iron ore).

Made one mixed gallon (3.79 l) of paint, and covered about 256 square feet (23.78 sq. m.).

(2.) WHITE LEAD PAINT, OLIVE COLOR.
325 pounds (147.42 kg.) white lead.
175 " (79.38 ") white lime.
75 " (34.02 ") French ochre.
3 " (1.361 ") Prussian blue.
1 pound (.454 ") burnt umber.
21 galls. (79.50 l.) boiled linseed oil.
1⅓ " (5.078 l.) turpentine.
1 " (3.79 l.) liquid drier.

Made 751 pounds (340.64 kg.) or 18 gallons (68.13 l.) of mixed paint, and covered about 512 square feet (47.56 sq. m.).

The iron work was first thoroughly cleaned, rough spots scraped, and such spots, together with all new rivets or other raw details, were "touched up" with one coat of metallic paint.

All the seams in top and bottom chords, gaps at brace joints, and all other cracks or seams needing it, were filled solid with linseed oil putty. The top surface of the top chords was then given one coat of metallic paint. The strap-iron, clips, fish-plates and under side of cross-ties, steel rails, and guard timbers, were painted one coat of same before adjustment. All cracks, joints, sun checks, etc., in the timber, were filled with putty prior to painting with metallic paint and again before using the white lead color.

The track superstructure received two coats of metallic paint. All track work being finished and the whole structure complete, the final covering of white lead paint was laid on with great care, under close inspection, and has proved, so far, to be the desideratum for iron surface painting. The actual cost of painting the structure, including the station girders, but not their buildings, with all the details of scraping, cleaning, puttying, together with all the materials and labor was $1.50 per lineal foot.

The labor account was 36 1/10 per cent. of the total cost.

While the material account was 63 9/10 per cent. of the total cost.

APPENDIX.

Form of estimate sheet of special street pier, built January, 1881, showing the exact construction, character of material in excavation, quantities, contract prices paid, and the total cost of the pier as ready for the column at connection with Harlem River Bridge, north end of Eighth avenue. (See Fig. 10.)

Nature of bottom, silt.
Bottom stones set, 2 (7′×3′×6″).
Bolts, 4—10′ 4″ = 672 lbs.
Washers, 4 = 108 lbs.
Base set, 1 = 3,200 lbs.
Refilling (62.50+73.11) — (13.49+16.92+22.67) = 82.62 cu. yds.

EXCAVATION:
Earth, 13′×13′×10′ = 62.50 cu. yds.
Loose rock, 13′×13′×11′.68 = 73.11 cu. yds.
Pit work, 13′×13′×12′.93 = 80.93 cu. yds.
Piling, 16 — 50′ = 800 lin. ft.
Capping, 4 — 9′×6″×12″, 18 — 9′×6″×6″ = 702 ft. B. M.
Concrete, 12′×12′×4′.23 = 83.46 cu. ft. Grillage = 19.58 cu. yds.

BRICKWORK:
Pier, 4′ 6″ sq. × 8′ 0″ sq. × 9′.083 — 21 cu. ft. (bottom stones) = 12.71 cu. yds.
Sub-pier, 8′×8′×7′.14 = 16.92 cu. yds.

ESTIMATE OF WORK DONE AND MATERIALS FURNISHED BY S. TIERNEY, CONTRACTOR.

QUANTITIES.	ITEMS.	AMOUNT.	REMARKS.
62.50 cu. yds.	Earth excavation @ $1 50..........	$93.80	The iron and bottom stones were furnished by the company.
73.11 " "	Loose rock excavation @ $3.00	219.33	
80.93 " "	Pitwork @ $2.00....	161.86	
800.—lin. ft.	Piling, @ $0 30....	240.00	
702.—ft. B.M.	Capping @ $35.00 per M..........	24.57	
19.58 cu. yds.	Concrete @ $5.00....	97.00	
29.63 " "	Brickwork @ $9.00	266.67	
2............	Bottom stones @ $2 00	4.00	
1............	Base set	4.00	
82.62 cu. yds.	Refilling @ $0 10..	8.26	
	Total	$1,120.48	

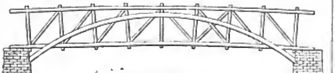
TRUSS-BRIDGES.

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

The following series of articles comprise an illustrated historical and chronological sketch of all the patents issued by the United States Patent Office, under the above head, which have expired and are now public property. As such, the ideas embodied herein are free to be used by any one so disposed. It is not contended that all of these inventions are useful and worthy of adoption, for the progress of bridge building since the conception of these devices, like the progress made in science and all the kindred arts, has rendered some of them obsolete and of interest only as a matter of history. It is the endeavor to make this class of inventions complete so far as patented devices are concerned, the period of whose protection has elapsed. The government granted them a monopoly of their inventions for a certain number of years, in return for which they agreed, as a part of the contract, to give their inventions to the world. Many of them are valuable and have come into general use, and will be recognized by the reader as forming a part of the bridge construction of to-day; while others, and perhaps equally meritorious, will appear for the first time in print, having never existed except upon paper and perhaps an experimental model or so. This is generally due to the absence of such business qualities in the inventor as will bring the invention before the public so as to secure its adoption.

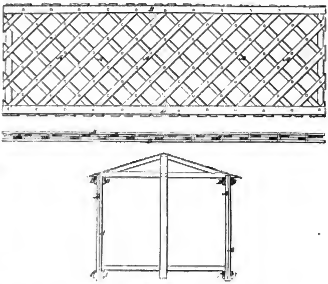
To bridge builders these articles, apart from their interest as a historical sketch, will have a special value, for they can readily ascertain what devices in bridge construction they can use without infringement of any patent right. They have a further value in that, should they receive notice from patentees to the effect that they are infringing any patented bridge, they can consult these papers in order to ascertain, so far as American expired patents are concerned, whether such is the case.



BURR'S TRUSS BRIDGE.

The first patent* ever granted by the United States Patent Office for a truss bridge, was issued to Theodore Burr, April 3, 1817. The drawing shows its general form. The lower chord of the bridge was laid upon the abutments or piers and supported the roadway. The following quotation shows how considerate and explicit an inventor was in those days in the details of construction: "The crown plates require to be raised above the floor sufficiently high to admit wagons or carriages, with any common load, to pass under the beams that lie crosswise and on top of the crown plates." Both the lower and upper chord, or crown plate, may be of two pieces, with king-posts embraced between them; or they may be single and put together by mortises. The diagonal braces are angled, as shown in the drawing, to obviate mortising. The inventor also designed placing a foot-walk outside the main bridge, and projecting for that purpose, the cross-beams of the roadway to support it. The arch sprang from the abutment from below or on the lower chord line to about the height of the bridge, and was either single or double. The inventor claimed such an arch made double or single; also the angled diagonal braces, without tenon or mortise, and the foot-way outside the bridge.

There is no doubt that this patent, in parts at least, was erroneously granted, for its general features were in existence in bridge building before that date. Moreover, the inventor, in 1837, filed a disclaimer, disclaiming the inclined planes on the abutments, the angled diagonal braces secured without tenon or mortise, and the foot-way arranged outside the bridge. This disclaimer is of interest as being the first ever entered by any patentee in the history of the Patent Office.



TOWN'S BRIDGE.

January 28, 1820, the Patent Office issued letters patent to one Ithiel Town. Fig 1 represents a side elevation of a section of the truss, and fig. 2 a top sectional view of the same. Fig. 3 is an end view. This drawing was destroyed by the fire of 1836, the original of the present drawing being made by the Patent Office from the specification of the patent. One series of the slat pieces *AA* are arranged parallel at an angle of forty-five degrees to a horizontal line; the other series crossing the first at right angles and having the same degree of inclination, forming an open lattice work. The longer the slats are in proportion to the distance between them, the smaller will be the area of the open work, and the more times each piece in one series will be crossed by those of the other series, consequently the greater number of joints, and therefore the more strength and less strain upon each joint when weight is applied to the bridge.

The timbers or chords *B B* take up the thrust strain. No lateral pressure is exerted against the piers or abutments. This bridge is designed to be covered, as shown in fig. 3.

In 1829 (Dec. 22), Lewis Wernwag got up an elaborate design for a bridge, shown by the accompanying drawings, which represent two modifications of bridge architecture. These bridges consist chiefly in having king-posts eight to twelve feet apart, and which are connected at equal distances by horizontal string pieces and stretchers by joining them by laps. The whole superstructure is made without mortise or

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Copyright, 1882.

* This patent of Burr's was in fact preceded by other bridge patents, which were unfortunately destroyed by the fire of 1836. It was attempted to restore these patents, but all efforts were unavailing, the authorities being unable to then obtain the address of the patentees. The following record of them is all that remains:

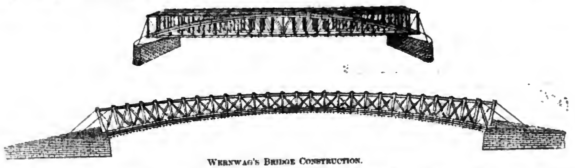
Charles W. Peale, Jan. 2, 1797, Penna.
Charles Fowler, Feb. 24, 1797, Penna.
John Stickoey, June 3, 1797, Mass.
Timothy Palmer, Dec. 17, 1797, Mass.
Theodore Burr, Feb. 14, 1806, Mass.
Thomas Pope, April, 18, 1807, N. Y.
John Templeman, Aug. 16, 1808, Md.
James Finley, June 17, 1808, Penna.
John Templeman, March 6, 1810, Md.
Joseph J. Deyster, Feb. 28, 1810, Penna.
Joseph Jessup, July 1, 1881, Penna.
Lewis Wernwag, March 28, 1812, Penna.
Benjamin Connor, April, 23, 1812, N. H.
George Tabb, Feb. 23, 1816, Va.

After the grant of Theodore Burr's patent of 1817 the following patents were granted, which were destroyed in the great fire and were never restored:

Naphtali Bishop, Jan. 11, 1819, Vt.
John Bragg, Jan. 4, 1820, Canada.
William Woodmansee, Mch. 6, 1827, Vt.
George W. Long, March 10, 1830, La.
George Law, June 12, 1835, Pa.
R. I. L. Whitley, Oct. 14, 1835, Mass.

With reference to these patents, however, it is not known whether they were for truss bridges, or bridges of other description.

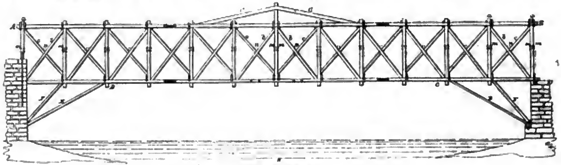
tenon. All the pressure is exerted endwise. The whole bridge is put together by screw-bolts in such manner that the bridge can be stiffened should any of the timbers shrink. The design of truss shown by the first illustration comprises one arch on each side of the bridge and one or more arches in the centre. These arches are made of segments of two or more splices or plies. The splices can be augmented, diminished, or changed at pleasure, without disturbing the other parts of the bridge, and a small place is left between them to allow the circulation of air so as to prevent dry rot. The bridge is braced by iron stay-rods.



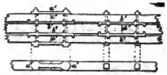
WERNWAG'S BRIDGE CONSTRUCTION.

One year afterward, in 1830, Mr. S. H. Long, who in signing the letters patent wrote after his name, "Top'l Eng'r, Brevet Lt. Col.," designed a bridge which he patented in March 6th of that year.

The drawing shows a side view of the truss frame. *A B* is the upper chord, and *C D* the lower, *a a* are the posts or uprights, *G G* are the superior arch braces, *E F* secondary braces under the second and third posts from either end of the truss, *b b* are the main diagonal braces, and *c c* the counter braces, *m m* are the clamp beams, and *n n* the floor timbers. The string pieces or chords are spliced by either wooden or iron splicing pieces.



LONG'S BRIDGE.

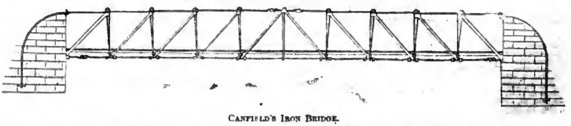


DETAILS OF SPLICED CORD.

The system of bracing employed exempts, so the inventor says, the truss frames from leverage in parts liable to be effected by such action. A system of counter bracing is also employed which renders the truss frame unyielding and stiff when the bridge is loaded or unloaded. The main braces and posts are designed to be furnished with metallic bearings, by the introduction of thin plates of iron or copper between the heel and toe of each main brace and the steps in the post against which they thrust. A mode of keying or wedging is employed by means of which the central parts of the truss frames of the bridge may be elevated and sustained in case of shrinkage or extraordinary compression of the timber.

This bridge was like, in many respects, the old Carrollton viaduct.

It was not till three years later that a patent was issued by the Office for bridge construction, when Augustus Canfield obtained protection for the first iron bridge ever granted by the United States. His papers are dated June 20, 1833. "The first upper strings," as the inventor calls them, or the chord-sections nearest the abutments, are firmly attached to the abutments and to the head of the first diagonal brace. To the head of the brace the head of the first post is attached, and also the "second upper string." To the foot of the first post is attached the first foot-piece, in which rests the foot of the second brace. The head of the second brace is sustained by the second upper string running from the head of the first brace and post. The first foot-pieces are prevented from moving horizontally by the second lower strings or chords, so that when the bridge is raised the upper strings are acted upon by a direct tension from the abutments, and the lower chords from a tension from the centre of the span. The floor timbers rest on beams supported by the lower cross-bars, and are of either wood or iron. The inventor says that spiral springs formed in the chords, as seen by the drawing, may be used if desired. He asserts that such a construction would leave every part at liberty to contract or expand without any strain, the chords yielding about an inch to two tons tension.



CANFIELD'S IRON BRIDGE.

(TO BE CONTINUED.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(Continued from page 369.)

CCCXC.—CAMDEN, N. J.

Camden, New Jersey, in lat. 39° 57' N., long. 75° 15' W., is on level ground, on the Delaware River, opposite Philadelphia.

It was incorporated as a city in 1831.

Water-works were built by a private company, about 1860, after plans of H. P. M. Birkinbine, C. E., taking the supply from the Delaware River. The water was led from the river in a wooden conduit to the engine house and then pumped by a Cornish engine through 2,880 ft. of 12-in. cast-iron pipe into a reservoir 180 by 344 ft. and 20 ft. deep. It is built in excavation and embankment, with inside slopes of 1 to 1, paved with brick. In the engine house is a plate-iron standpipe 5 ft. in diameter and 123 ft. high. There was also a Whiting auxiliary steam pump.

In July, 1870, the works were purchased by the city for $200,000. They were then in very dilapidated condition. The Whiting pump was removed and a Worthington high-pressure engine and pump put in its place. The reservoir, which contained 600 tons of sediment, was cleared and in the following year a 30-in. pump main was laid. A 30-in. distributing main was laid across Cooper's Creek. It was laid in a trench, dredged in the bottom, 200 ft. long and 33 ft. below high water, using a flexible joint designed by Jacob H. Yocum.

In 1882 a Blake pumping engine of 5,000,000 gallons capacity was erected.

Distribution is by cast-iron pipe, of which 36.5 miles of from 30 to 3-in. diameter are in use, with 285 fire hydrants and 7,070 taps. Lead service pipes are used.

The population in 1880 was 41,658, and the daily consumption in 1881 was 2,111,000 gallons.

The expenses of the Water Department from January, 1871, to January, 1882, was $329,323.13.

The expenses for 1881 were $26,340.44, and the receipts $65,644.63.

The works are managed by a Water Committee of five members of the Council. William D. Middleton is the Superintendent.

CCCXCI.—DUNKIRK, N. Y

Dunkirk, New York, in lat. 42° 30' N., long. 79° 30' W., is on level ground on Lake Erie.

Settled in 1815, it was incorporated as a city in 1880. Water-works were built for the village in 1871 by the Holly Manufacturing Company, taking the supply from the lake, and pumping it directly into the mains by 4 piston pumps of 9-in. bore and 24-in. stroke, driven by a steam engine. There are also 2 rotary pumps for fire pressure. The water is taken to the pumps through a cast-iron pipe laid to a crib in the harbor 700 ft. from the shore in 5¼ ft. water. The ordinary pressure is 45 lbs. and the fire pressure 100 lbs.

Distribution is by 14 miles of cast-iron pipe of from 12 to 35 in. diameter, with 96 fire hydrants, 75 gates and 510 taps. Service pipes are of galvanized iron. Complaint is made that the mains are too small. The population in 1880 was 6,900, and the daily consumption in 1881, 900,000 gallons.

The works have cost $110,000. The bonded debt is $100,000 at 7 per cent.

The expenses of maintenance in 1881 were $7,300, and the receipts $5,600.

The works are managed by a Board of Commissioners. John Madigan is the Secretary, and J. C. Richardson the General Superintendent.

CCCXCII.—EVANSVILLE, IND.

Evansville, Indiana, in lat. 38° N. long. 87° 37' W., is on a bluff on the Ohio River. Settled in 1812, it was incorporated as a borough in 1814 and as a city in 1847.

Water-works were built for the city in 1870 by the Holly Manufacturing Co., taking the supply from the Ohio river and pumping directly into the mains. The suction pipe from the pumps is of 24 in. diameter and leads directly to the river, with a 16 in. branch which extends about 1,200 ft. up the river to three filter boxes 15 ft. in diameter and 6 ft. deep sunk in the river bed. These have never been finished and used. The main suction pipe sometimes becomes choked with sand and leaves.

The first pumps were 12 piston pumps of 14 in. bore and 14 in. stroke, worked by a Holly steam engine. In 1880 a Gaskill engine, driving 4 pumps of 18 in. bore and 36 in. stroke, was erected.

The ordinary pressure is 40 lbs. and the fire pressure 80 lbs.

Distribution is by 27 miles of cast-iron pipes, of from 20 to 4 in. diameter, with 227 fire hydrants, 109 gates and 1,287 taps. The city contributes $11,130 per year for public water. Service pipes are of galvanized iron.

The population in 1880 was 29,280, and the daily consumption in 1881 was 3,500,000 gallons.

The works have cost $500,000. The bonded debt is $300,000 at 7$\frac{3}{10}$ per cent. interest.

The expenses in 1881 were $86,076.28, and the receipts $89,329.97.

The works are managed by a committee of three of the City Council. Charles Newman is the Secretary, and Baker W. Reynolds the Superintendent.

CCCXCIII.—LANCASTER, PA.

Lancaster, Pennsylvania, in lat. 40° 5' N., long. 76° 30' W., on the Conestoga Creek, is on undulating ground, rising to 100 ft. above the stream. Settled in 1718, and then called Hickory town, its name was changed to Lancaster in 1730. It was incorporated as a borough in 1742 and as a city in 1830.

Water-works were built by the city in 1836 after plans of Frederick Erdman, taking the supply from Conestoga Creek. A crib and stone dam 7 ft. high, created a storage reservoir and also furnished power to a water-wheel which drove two sets of upright plunger pumps of 30 in. stroke. There are three pumps in each set. There was also a horizontal Rush & Muhlenberg pump. A Worthington high-pressure steam pump of 500,000 gallons daily capacity was afterwards added. A Worthington duplex engine of 3,000,000 gallons capacity was added in 1878.

The water is lifted 200 ft. through 4,864 ft. of cast-iron pipe into two reservoirs built in excavation and embankment, of 2½ and 3¼ million gallons capacity. There is also a standpipe of 5 ft. diameter, 40 ft. high, for high service supply.

Distribution is by 32 miles of cast-iron pipe, of from 20 to 4-in. diameter, with 300 fire-hydrants, 240 gates and 3,500 taps. There are 2 meters in use. The city pays for the hydrants. Lead and wrought-iron service pipes are used.

The population in 1880 was 25,846. The daily consumption in 1881 was 3,000,000 gallons. The original works cost $77,000. With additions they have cost $300,000. The water debt is not separated from other city indebtedness. The expenses in 1881 were $9,934, and the receipts $38,000. The works are managed by a committee of three members of each branch of the City Council, the Mayor, J. T. Macgonigle, being chairman.

CCCXCIV.—MACON, GA.

Macon, Ga., in lat. 32° 50' N., long. 83° 40' W. is on the Ocmulgee River. The business portion is on level ground between the river swamp and a range of hills on which the residences are mostly situated.

Settled in 1822, it was incorporated as a town in 1823 and as a city in 1832.

Water-works were built by a private company in 1881, after plans of A. E. Boardman, C. E., taking the supply from springs about 2 miles from the centre of the city. The water is conducted into a large well and pumped thence through 7,780 ft. of 12 in. pipe by a Worthington duplex steam pump, with steam cylinders of 12 and 20 in. and water cylinders of 10 in. bore and 15 in. stroke. It is lifted 150 feet into a reservoir 220 by 100 ft. and 26 ft. deep, built on a side hill in excavation and embankment, puddled and lined with concrete 6 inches thick. The surface is 127 ft. above the city. Distribution is by 9.6 miles of cast-iron pipe of from 12 to 4 in. diameter, with 58 fire hydrants, 59 gates and 216 taps. There are 104 meters in use. The city pays $60 per year for each fire hydrant. Service pipes are of galvanized iron.

The population in 1880 was 12,748, and the daily consumption is 175,000 gallons.

The capital stock of the Macon Gas-light and Water Company is $150,000. The water-works have cost $78,000. The bonded debt is $75,000 at 6 per cent. interest. The expenses for the year ending March 31, 1882, were $2,460, and the receipts $6,320.

J. M. Boardman is the President, and A. E. Boardman the Treasurer and Superintendent.

CCCXCV.—MANSFIELD, OHIO.

Mansfield, Ohio, in lat. 40° 45' N., long. 82° 35' W., is on elevated ground on the Rocky Fork of the Mohican River. It was settled in 1814.

Water works were built for the city in 1872, by the Holly Manufacturing Company, taking the supply from 2 springs, at one of which a reservoir holding 1,500,000 gallons is built. From this the water is pumped directly into the mains, piston pumps and rotary pumps for fire pressure, driven by a Holly steam engine. The ordinary pressure is 80 lbs., and fire pressure 100 to 125 lbs.

Distribution is by 17 miles of cast-iron pipe of from 16 to 4 in. diameter, with 115 fire hydrants, 85 gates and 657 taps. Wrought-iron service pipes are used. The population in 1880 was 9,992, and the daily consumption in 1881 was 600,000 gallons. The works have cost $292,000, and the receipts have been $40,721.47. The bonded debt is $95,000 at 6 and 8 per cent. interest.

The expenses in 1881 were $5,204.44, and the receipts $6,715.63.

The works are managed by three trustees elected popular vote.

H. R. Smith is Secretary and Treasurer, and E. McCoy the Superintendent.

CCCXCVI.—NILES.

Niles, Michigan, in lat. 41° 53' N., long. 86° 20' W., is on undulating ground on the St. Joseph River. Settled in 1828, it was incorporated as a village in 1838. Water-works were built for a private company in 1878 by S. L. Wiley, taking the supply from Barron Lake, a small pond 5 miles from the town, fed by springs, and conveying the water in a 12 in. wrought-iron and cement pipe to a reservoir holding 800,000 gallons at 106 ft. above the city.

Distribution is by 8 miles of cement-lined wrought-iron pipe of from 12 to 4 in. diameter, with 50 fire hydrants and 800 taps. The town pays $50 per year for each hydrant. Service pipes are of wrought iron coated with tar.

The population in 1880 was 4,500. The daily consumption is 250,000 gallons.

No financial statistics are given.

S. L. Wiley is President, and C. T. Wiley, Superintendent.

CCCXCVII.—SACRAMENTO, CAL.

Sacramento, California, in lat. 38° 34' N., long. 121° 20' W., is on level ground at the junction of the Sacramento and American Rivers. In a great freshet in 1850 the whole city was flooded, after which the grade of the streets was raised 5 ft., making the city now about 8 ft. above water.

Settled in 1839, the first frame house was built in 1849. It was incorporated as a city in 1863.

Water-works were built in 1854 by the city, taking the water from the Sacramento River. No account of the early works is furnished. There are now in use a Holly pumping engine, of 3,000,000 gallons capacity, erected in 1873, and a larger engine, designed by A. J. Stephens, recently erected. There is near the pump house an elevated tank holding 250,000 gallons. Water is generally pumped directly into the mains with 40 lbs. pressure and 70 lbs. fire pressure.

Distribution is by 23 miles of pipe of from 24 to 3-in. diameter, principally of cast-iron. Several thousand feet of wrought-iron mains have been laid recently. There are 285 fire hydrants, 150 gates and 4,600 taps. Wrought-iron service pipes are used. The population in 1880 was 21,420. The daily consumption ranges from 1,000,000 gallons in winter to 3,000,000 gallons in summer.

The first works cost $140,000. The cost to the present time has been $350,000. There is no debt. The expenses in 1881 were $25,000, and the receipts $68,500.

The works are managed by a Board of Trustees. William Guttenberger is the Superintendent.

CCCXCVIII.—WEST SPRINGFIELD, MASS.

West Springfield, Massachusetts, in lat. 42° 6' N., long. 72° 31' W., is on the Connecticut River. It was detached from the town of Springfield and incorporated in 1774.

Water-works were built in 1874 for a private company by Goodhue & Birnie, taking the supply from Darby Brook, a stream flowing through a sandy water-shed of 400 acres area. It is impounded by a dam 250 ft. long and 17 ft. high, built entirely of puddled clay. It has never leaked. The reservoir thus formed covers 4 acres at 95 ft. above the village.

Distribution is by 8 miles of cement-lined, wrought-iron pipe of from 16 to 6 in. diameter, with 14 fire hydrants, 17 gates and 275 taps. The town pays for and maintains the hydrants and pays $1,000 per year for their use. Service pipes are of 1-in. gas pipe, lined with ⅛ in. of clear cement.

The capital stock of the company is $50,000. There is no debt. No further financial statements are given.

Goodhue & Birnie own and manage the works.

(TO BE CONTINUED.)

The receipts of statistics, as follows, is acknowledged with thanks: From H. R. Smith, Secretary and Trustee, statistics and water rates of the water-works of Mansfield, Ohio. From Goodhue & Birnie, contractors, statistics of the water-works of West Springfield, Mass. From the Mayor of the city, J. T. Macgonigle, statistics of the water-works of Lancaster, Pa. From J. C. Richardson, General Superintendent, statistics and water rates of the water-works of Dunkirk, N. Y. From A. E. Boardman, Superintendent, statistics and water rates of the water-works of Macon, Georgia. From S. L. Wiley Construction Co., statistics of the water-works of Niles, Michigan. From L. F. Bassett, statistics and water rates of the water-works of Sacramento, Cal. From Baker W. Reynolds, Superintendent, statistics and water rates of the water works of Evansville, Ind. From W. P. Osler, Assistant City Surveyor, statistics and reports of the water-works of Camden, N. J.

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S. D. V. BURR..............ASSOCIATE EDITOR.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

JOINT SESSION OF ENGINEERING SOCIETIES.

There will be a joint session of the American Institute of Mining Engineers with the American Society of Civil Engineers and the American Society of Mechanical Engineers at the Turf Club (formerly Union League) Theatre, corner of Madison avenue and Twenty-sixth street, New York, on Wednesday evening, Nov. 1, at 8 o'clock, for the purpose of hearing the memorial address on the life and works of the late Alexander Lyman Holley, to be delivered by R. W. Raymond, Ph. D.

THE attention of our readers is called to the advertisement on Page X. of "An Executive Manager."

TO KNOW what engineering devices have been patented is rapidly becoming a necessity in the practice of the modern civil engineer. It has become the fashion among technical journals to devote a considerable share of their space to the illustration and description of new patents; the two great engineering journals of England have, in the past two years given very particular attention to this class of news, and their example has been imitated in a small way by several of our American class publications. ENGINEERING NEWS has not the space nor the inclination to give to every little device that is patented. We have, however, endeavored to recognize the importance of this subject by obtaining for publication a carefully selected list of new inventions, or improvements, through a competent patent attorney, so that our readers may learn in time of what might assist, or embarrass them in their practice. The business of bridge-building has become so enormous in its volume, and competition in it is becoming so keen, that everything relating to it is of interest to civil engineers and contractors. The readers of ENGINEERING NEWS will, therefore, be interested in Mr. Brock's delvings amid the dusty records of the Patent Office, the results of which we publish under the title of "Bridge Trusses," showing what has been patented but is now free to any person who may wish to use the same. We consider this information too valuable to go out of print with the current issue of each week's installment, and so it has been arranged for publication in book form hereafter. Mr. Brock is making a specialty of engineering patents, and we doubt not his collation of these bridge specifications will commend him to the profession. Every bridge device, the patent of which has expired, will be described and illustrated, after which the patents in force may be considered.

WE have given before the names of the following cities of over 10,000 inhabitants from which no replies have been received to repeated requests for water-works statistics. There are about 150 smaller cities and towns in the same category. We call attention to this fact, and hope that some one of our readers will either send the desired information to Mr. Croes, or stir up the officers of the works in his town to send it.

Biddeford, Me.
Brockton, Mass.
Burlington, Vt
Canton, O.
Chattanooga, Tenn.
Cohoes, N. Y.
Columbus, S. C.
Davenport, Ia.
Dover, N. H.
Easton, Pa.
Haverhill, Mass.
Hyde Park, Ill.
Joliet, Ill.
La Crosse, Wis.
Lewiston, Me.
Little Rock, Ark.
Los Angeles, Cal.
Mobile, Ala.
Muskegon, Mich
Portland, Or.
Pottsville, Pa.
Rock Island, Ill.
Rutland, Vt.
Saginaw, Mich.
San Jose, Cal.
Shenandoah, Pa.
Springfield, Ill.
Stamford, Conn.
Stockton, Cal.
Steubenville, O.
St. Joseph, Mo.
Wheeling W. Va.
Youngstown, O.

◆

THE CHICAGO PLUMBERS VERSUS THE DURHAM SYSTEM OF HOUSE DRAINAGE.

The Chicago Plumbers' Union, after the manner of their compatriots in the House of Commons, are developing considerable ability as obstructionists.

The Durham system of drainage is the object of their hate in the present instance. From individual efforts to obstruct the Durham Company's pipes by deposits of pitch, sand and cement, they have risen to the dignity of open and united action against the further spread of a system which dispenses with plumbers.

One of their number having imprudently and impudently entered into a contract to execute the drainage work of a certain county court-house, according to the patented Durham system, at a price 25 per cent. below the open bid of the Durham House Drainage Co., of Chicago, and being prevented by the architect from ignoring the specifications and substituting the ordinary plumbing work for the Durham system, which he attempted to do, finds himself in the predicament of being under bonds to furnish a class of work beyond his reach. He then modestly requests the Durham Company to complete his contract *for the amount of his bid*, some $400 less than the company's bid, and at a loss to the company of about one hundred dollars. This proposition was declined, because Mr. Plumber had gone into the speculation with his eyes open, having been notified both personally and in writing, at the time of the letting of the contract, that he was trespassing to his own certain damage. Failing in this, he goes to his Union with his grievance and demands that they support him in making war on the Durham system, because the inalienable right of the plumbers to do bad work and do it often was in danger of suppression. The Union loyally responds and takes up the pot and ladle in defense of their lamenting brother. It was unanimously decreed that the Durham system is not *new*, "that it had been in use for years in jails, insane asylums and similar institutions; and that it was directly opposed to all the rules of sanitary science, and in direct violation of the laws of boards of health, city, state, and national." A vote of censure on the brother who had undertaken to perpetuate this vicious system would have been properly in order, but in the enthusiasm of the moment the matter was overlooked.

The campaign was vigorously opened; the building trades being in a depressed condition, time was abundant with the plumbers. They began the attack on the new Chicago City Hall—naturally. Two members of the Union are Aldermen—they are also experts and "SANITARY ENGINEERS." This fact cannot be discredited, because the *American Artisan*, a Chicago paper, makes the statement. But in fairness it must be mentioned, for the information of those not familiar with the status of sanitary science in Chicago, that it is the unwritten law there that the assumption of the trade or calling of plumber or sewer builder, or the engaging in the business of selling clay sewer pipe, entitles any person to the designation of "Sanitary Engineer." We are not prepared to make a positive statement to that effect, but we have the impression that the College of Plumbers confers the degree of S. E. Hence when one hears the appellation applied to a Chicago person, while it may not follow that he is the agent of some sewer pipe company, or carries on business from some dark basement as a drain-layer, yet it is not safe hastily to assume that he is the peer of Rawlinson or Shedd.

The two plumbers who were Aldermen were, of course, quite at home in matters pertaining to the City Hall, and the Durham system in that building was incontinently overhauled and investigated. We quote sundry extracts from the Chicago papers of recent dates:

"Ald. Ryan offered the following:

"Whereas, What is known as the Durham system of sewerage, soil and waste-pipes has been introduced into the new City Hall; and,

"Whereas, Such system and such work is faulty in construction and against all sanitary laws.

"*Resolved*, That the Committee on Public Buildings be and are hereby instructed to call to their aid a sanitary engineer or engineers to investigate into and report upon said system of drainage as applied to the new City Hall.

"Referred to the Committee on Buildings."

"One of the Aldermen, after the drainage is all in the City Hall, has suddenly discovered that the system is all wrong, and that there should be a radical change. How does it happen that he has just discovered that the kind of iron pipes being used is not as good as some other kind of iron pipe? He was one of the Aldermen who was around when the contract was given out. There had been a large amount of the same kind of pipe, put in at Pullman, and in many of the best houses in the city. It was no new thing, and hence how does it happen that the Alderman in question, with all these cases before him, has just discovered that the wrought-iron pipe is a failure? Either he has been negligent of his duty in not having attended to this matter before, or else he has some other kind of pipe which he wishes to take the place of that in use."

"THE DURHAM SYSTEM ALLEGED TO BE DEFECTIVE.—The Durham system of drainage introduced in the new City Hall of Chicago is criticised from a sanitary standpoint. Alderman Ryan, himself a sanitary engineer, proposes the appointment of Col. Waring, or some other competent engineer, or a board of sanitary engineers to investigate the Durham system and decide whether it is defective as a sanitary system before it is too late to mend matters. Alderman Ryan is of the opinion that it *is* defective. If the Council refuses to have an inspection of the sewerage of the new City Hall made, the Plumbers' Union proposes to have it done."

We also append a few communications from engineers, who possibly may be recognized as authority quite equal to that of Alderman Ryan, "Sanitary Engineer," and his brethren of the Plumbers' Union:

DEPARTMENT OF PUBLIC WORKS,
COMMISSIONER'S OFFICE, CHICAGO, Sept. 23, 1882.

Floyd B. Wilson, Esq., New York:

SIR: This note is addressed to you at the request of Mr. C. W. Durham, to say that I recommended his System of House Drainage for the new City Hall of this city because I regarded his plans as a great improvement over the ordinary mode of doing such work, and the material used to be superior to that entering into work of the kind ordinarily. * * *

Respectfully, DEWITT C. CREGIER.

Office of BURNHAM & ROOT, Architects,
115 DEARBORN STREET, CHICAGO, Sept., 23, 1882.

DEAR SIR: There seems to us no requirements of perfect sewering which the "Durham House Drainage" does not meet.

We have used the system for four years, at times putting in as many as six water-closets in a single dwelling, or thirty odd in an office building. We have tried it under varying conditions, from basement to garret, from extreme cold to high heat, in moist and dry atmospheres, and feel competent therefore to give an opinion. We indorse the system emphatically; never having had a word of complaint in any instance of the very large number of cases where it has been applied in our practice.

We have used it more than one hundred times.

Yours very truly, BURNHAM & ROOT.

F. B. WILSON, Esq., 140 Nassau St., N. Y.

171 LA SALLE ST., CHICAGO, Sept. 28, 1882.

Floyd B. Wilson, Esq., 140 Nassau St., New York:

DEAR SIR: During two years past the Durham System of House Drainage has been used in 1,200 or 1,300 houses at Pullman, where I have had charge of the sewerage work. I advised its use for the reason that I consider it the nearest perfect of any work used for such purpose, owing to the absolute certainty of securing tight joints if ordinary care is used, and for the further reasons that the material used and the method of supporting the closets are superior to that in ordinary use.

Great satisfaction has resulted from the use of the work at Pullman. Very truly,

BENNETTE WILLIAMS, Civil Engineer.

DEPARTMENT OF PUBLIC WORKS,
Office of Consulting Engineer,
31 CHAMBERS ST., ROOM 10, NEW YORK, Oct. 14, 1881.

Mr. C. W. Durham:

MY DEAR SIR: Having examined your System of House Drainage construction, and having known you for a long time, I feel satisfied that you not only have an excellent combination of design, material and workmanship but that you will perform your contracts faithfully and skilfully.

Yours very truly, **E. S. CHESBROUGH.**

PHILADELPHIA, Sept. 24, 1882.

C. W. Durham, Esq., C. E.:

DEAR SIR: I see no reason why I could not recommend your System as an efficient and safe one, and, therefore have no objection to your using my name as endorsing it to that extent.

Yours truly,
RUDOLPH HERING.

* * *

NEW ENGLAND WATER-WORKS ASSOCIATION.

The above-named Association met at the Essex House, Salem, Mass., on Wednesday, Oct. 11. The meeting was called to order at 11 o'clock, President Lyon in the chair. Six applications for active and three for fine membership were received and considered, after which the candidates were duly elected members of the Association.

An informal discussion was had on the subject "of the best methods of detecting and preventing the waste of water."

Hiram Nevins of Cambridge, Edwin Darling of Pawtucket, and Frank Hall of Worcester, were appointed a committee to prepare a paper for discussion at the next meeting on the topic, "The causes and prevention of the waste of water."

C. W. Morse of Haverhill, A. S. Glover of Newton, H. G. Holden of Lowell, Edwin Darling of Pawtucket, and J. W. Lyon of Salem, were appointed a committee to prepare a paper for discussion at the next meeting on the topic, "Uniformity in compiling annual reports."

A. S. Glover of Newton, A. F. Noyes of Newton, and H. W. Rogers of Lawrence, were appointed a committee to prepare a report for discussion at the next meeting on the subject of "Water Meters."

Mr. Darling presented a copy of the record of duty made by the Corliss pumping engine at Pawtucket, R. I., for the seven months ending Aug. 31, 1882. This interesting record was carefully examined by many of those present and the copy presented to the meeting was ordered on file.

After the adjournment of the business meeting dinner was served, at the close of which the Hon. Samuel Calley, mayor of Salem, addressed the Association, extending a cordial welcome to the city of Salem. Addresses were also made by Albert A. Haggett, president of the Lowell Water Board, and President Lyon.

The members of the Association were then driven to the different interesting points of the Salem water-works.

At the pumping station at Wenham Lake, a vote of thanks was extended to President Lyon for his active endeavors and ample provision for the comfort and pleasure of the members upon this occasion.

LIST OF MEMBERS OF THE NEW ENGLAND WATER WORKS ASSOCIATION.

Active Members.

R. W. Bagnell, Superintendent, Plymouth, Mass. J. Stewart Brown, Registrar, Worcester, Mass. James M. Battler, Clerk, Lowell, Mass. Jonas M. Clark, Superintendent, Northampton, Mass. R. C. P. Coggeshall, Superintendent, New Bedford, Mass. J. Warren Cotton, Registrar, Cambridge, Mass. Edwin Darling, Superintendent, Pawtucket, R. I. William T. Dotten, Superintendent, Winchester, Mass. Albert S. Glover, Registrar, Newton, Mass. Robert M. Gow, Superintendent, Medford, Mass. S. E. Graunis, Superintendent, New Haven, Conn. Frank E. Hall, Commissioner, Worcester, Mass. Joseph C. Hancock, Superintendent, Springfield, Mass. James H. Hathaway, Registrar, New Bedford, Mass. W. W. Hawkes, Superintendent, Malden, Mass. William F. Hill, Superintendent, Dedham, Mass. Horace G. Holden, Superintendent, Lowell, Mass. H. N. Hyde, Jr., Superintendent, Newton, Mass. Moses Joy, Jr., Superintendent, Milford, Mass. Addison Lane, Superintendent, Melrose, Mass. Thomas C. Lovell, Superintendent, Fitchburg, Mass. James W. Lyon, Superintendent, Salem, Mass. A. H. Martine, Superintendent, Fall River, Mass. C. W. Morse, Superintendent, Haverhill, Mass. Hiram Nevons, Superintendent, Cambridge, Mass. Albert F. Noyes, City Engineer, Newton, Mass. W. H. Richards, Superintendent, New London, Conn. Henry W. Rogers, Superintendent, Lawrence, Mass. H. L. Schleiter, Superintendent, Meriden, Conn. Phineas Sprague, Registrar, Malden, Mass. Joseph G. Tenney, Superintendent, Leominster, Mass. Charles K. Walker, Superintendent, Manchester, N. H. William C. Wilcox, Registrar, Waltham, Mass. Horace B. Winship, Superintendent, Norwich, Conn.

Fine Members.

National Meter Co., New York. J. J. Newman & Co., Water-Works Contractors, Providence, R. I. W. B. Sherman, Hyd. Engineer, Corliss Steam Engine Co., Providence, R. I.

* * *

SPECIFICATIONS FOR PUMPING MACHINERY.

Nashville, Tenn., will receive proposals until 12 o'clock, noon, of Friday, November 10, 1882, for furnishing two first-class pumping engines.

Each engine is to have an easy capacity of 10,000,000 U. S. gallons in 24 hours, against a resistance equal to pumping from the Cumberland River, the source of supply, into the proposed storage reservoir, through a 36 inch force main, about 8,000 feet long. The extreme difference between high and low water in the river is about 55 feet, and the flow line in the reservoirs will be about 280 feet above low water in the river. The floor line of engine room will be 62 feet above low water level.

Each proposal must state the kind of engine offered, including a descriptive specification, sufficently in detail to describe the material, method and mechanicism of interior and exterior working parts: and must be accompanied by the necessary plan, elevation and sectional drawings.

The contract will include the furnishing of all transportation, tools, materials, labor and fixtures; and also the furnishing at the station of all iron work required in the construction of foundation masonry.

This contract will also include the necessary hot well or wells, feed pumps, air-pumps, check and foot valves, steam and vacuum gauges and counters: also the lubricators, oil-pumps, cans, etc.; also furnishing, connecting and putting in place of all steam pipes inside the engine-room, together with the necessary pipes, valves, cocks, curves, etc.

The steam cylinders must be steam-jacketed, and all parts subject to loss of heat by radiation to be protected by placing next the metal a plastic composition compound of asbestos, or other acceptable material, over which will be placed at least one thickness of hair felting, and over all an ornamental wooden lagging.

Each engine to be supplied with the necessary air-chambers, on suction and delivery mains, also with foot-valves in suction pipes, and check-valves in delivery mains, at such points as may be directed by the engineer.

Steam pipes to be of wrought-iron, screwed together and thoroughly red-leaded. Connecting flanges to be lathe-faced, and made to correspond in size.

Each bid must stipulate the duty to be guaranteed, which shall not be less than 60,000,000 pounds of water raised one foot high per 100 pounds of coal consumed, without taking account of ashes or clinkers, or making any deductions of any kind. The duty will be determined, first, by a continuous run of 24 or 48 hours, at the option of the engineer, during which the full contract quantity of water will be pumped; second, by actual records taken for a period of 30 days, during which the engines will be operated at contract speed for half the time, or during each alternate 12 hours. Bidders will stipulate and guarantee the duty under each of these conditions. Steam will enter the cylinder at not over 70 pounds per square inch during the tests, and the duty will be computed on a basis of evaporation in the boilers of 8 pounds of water per pound of coal consumed—variable either way proportionate to the variation of actual evaporation from above rate. The pressure to be maintained during the tests will be 218 feet above floor line in engine rooms, plus the distance from floor to surface in pump well. No allowance will be made for friction in pumps or machinery.

The engines and appurtenances to be kept in good working condition for one year from the date of their completion.

The foregoing is but a brief synopsis of the main points in regard to the engines. The specifications are intended to describe a pumping service which shall be first-class in every particular.

Further particulars can be obtained from Thomas A. Kercheval, mayor of Nashville, or J. D. Cook, C. E., the consulting engineer, Toledo, O.

PERSONAL.

MR. RUFUS COOK is Chief Engineer of the Pemigewassett Valley Railroad. Headquarters at Plymouth, N. H.

A DISPATCH to the *World* from San Antoino, Texas, dated the 25 inst., says:

MAJOR R. W. PITRIKEN, Chief Engineer of the Mexican & Oriental Railway, was murdered by Indians in the mountains near Chihuahua, two days ago.

ROBERT A. SHAILER, late Assistant Superintendent Edge Moor Iron Co., has been appointed Engineer Department Bridges and other structures, C. M. & St. P. Ry.

MR. L. M. MUZZEY, of ADAMS & MUZZEY, Civil Engineers, Boston, is employed by the city of Keene, N. H., as Superintendent and Inspector of the Waring system of sewerage, now being introduced into that city.

HENRY ROBINSON SEARLE, a well-known architect during 25 years in Rochester, Washington, D. C., and New York City, member of the American Institute of Architects, of the Philosophical Society of Washington and the Union League Club, died in this city last Sunday morning, aged 46 years.

Of iron men named KRUPP there are two in Germany having A. for their sole initial. Both originally belonged to the same firm, and how they became separated forms an interesting story, which has just been told in Paris, where Herr ARTHUR KRUPP recently arrived. In 1855 the KRUPPS, by being thus together, took to casting guns at their factory, and in 1863 made the weapon which took the first prize at the French Exhibition of 1867. Soon after this the firm proposed to Marshal Niel and Gen. von Moltke to cast for both their governments respectively, an offer which was the cause of the retirement of ARTHUR KRUPP, who founded, thereupon, an iron foundry at Berndorf, in Austria, and left ALFRED to conduct the works at Essen. ARTHUR's foundry, outside of Europe, if still there, is not heard of, but ALFRED's gun business is the wonder of the world, as the statistics will show that it ought to be. The population of the Essen works is 15,700, and the number of boilers and engines is as follows: 429 boilers, 858 steam engines, with a horse-power of 18,500; 82 steam hammers, and 1,556 furnaces, of which fourteen are high furnaces, producing 300,000 tons of steel and 26,000 tons of iron yearly.

* * *

RECENT INVENTIONS PATENTED DURING THE PRESENT WEEK.

SAFETY GUARD FOR RAILWAY SWITCHES.

The invention consists of a reversable elastic cushion having its upper and under faces alike, and made with longitudinal central grooves extending from end to end. The sides fit snugly against the vertical faces of the adjacent rails and against the under faces of the heads of the rails and rest upon the feet of the rails.

MAGNETO-ELECTRIC RAILWAY SIGNAL.

The magneto-electric signal is arranged in a circuit between the switch-operating mechanism and a magneto-generator, whereby when the circuit is closed (by the proper alignment of the switch) an approaching train in operating the generator gets a safety signal; but when the circuit is open (through the misplacement of the switch) no safety signal can be produced.

TELEPHONE CIRCUIT AND APPARATUS.

This novel arrangement of speaking and listening telephone circuit comprises a series of central-office switch-boards, and a circuit-changer located at a supervising desk. All the telephone circuits are looped through the supervising desk, to which is attached a supervising telephone. An auxiliary signaling-circuit is employed, which is provided with nominally open branches connecting respectively with magneto-generating machines and with a battery. A switch controls the signaling circuit, and a separate switch controls the supervising telephones and connecting devices, whereby either signaling or telephone circuit may be included in either of the switch-board telephone circuit loops. A circuit-changer is located at the chief operator's desk.

ECCENTRIC FOR STEAM ENGINES.

In this invention a balance or counter weight is secured to an adjustable eccentric in such position as to exert its gravity upon the eccentric in a reverse direction to the action of the steam pressure upon the stem of the valve, attached by the eccentric.

STEAM PUMPING ENGINE.

A new steam pump consists of two steam and two water cylinders, secured together upon the same axial line, and provided with a continuous plunger. They are combined with yokes and gear wheels for converting the reciprocating motion of the piston into rotary motion of the shaft. Eccentric and valve connections are operated by said shaft and communicate alternating motion to the valves of each of the steam cylinders.

OPERATING CABLE RAILWAY GRIPS.

This improvement relates to cable railways. Upon a frame are secured gripping-jaws connected to an operating lever, to which is secured a supplemental power hand-wheel, suitably journaled and provided with a pinion, which engages with a curved segment rack. A ratchet wheel and pawl, operated by a hand-lever also journaled and attached to the hand-wheel to retain the parts in position when set.

ELECTRIC SAFETY DEVICE FOR ELEVATORS.

In this invention, a frangible or separable electric conductor is combined with an elevator and traverses the portions of the hoisting machine or motor which are subjected to the working strain or wear and arranged in a closed electric current including an electric magnetic detent which controls safety catches arranged to uphold the car, whereby the breaking of the parts of the motor so traversed will break the electric circuit and thereby relax the magnetic detent and release the safety catches to uphold the car.

WASHINGTON, D. C. F. B. BROCK.

CORRESPONDENCE.

CONVENTIONAL COLORS.

PITTSBURGH, Pa., Oct. 21, 1882.

EDITOR ENGINEERING NEWS:

I should like to hear from some of your readers as to what is the general practice regarding the use of *colors* for the various lines of a railroad survey map. I would like to know what are the proper (or usual) colors to use for the preliminary lines, location lines, changed or altered lines, contours, etc.?

I notice that on different railroads the practice differs and a full discussion of this subject might lead eventually to a system of uniformity, the advantages of which are obvious to all.

Respectfully,
L. E. VEL.

SPIRAL CURVES.

COLORADO SPRINGS, Colo., Oct. 24, 1882.

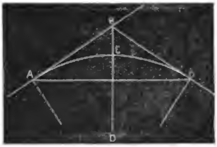
EDITOR ENGINEERING NEWS:

In your issue No. 10 (dated March 11) of this year, Mr. W. H. Fry, in the latter part of his article on spiral curves, says:

"Having laid out the end of the first spiral, which falls on station 21, by deflecting from the tangent 51½ minutes, as above, set up the transit at station 21. Take a backsight on station 20 with 51½ minutes on the other vernier, turn vernier to zero, when the line of collimation will be a tangent both to spiral and circular curve to be laid out."

Referring to the accompanying diagram, let *A B* be the tangent mentioned above as being deflected from, and *B C* the "tangent both to spiral and to circular curve." *A* is station 20 and *C* is station 21.

If I understand the above statement, it says in substance that the angles *B A C* and *B C A* are equal, each being 51½ minutes; and the curve *A E C* is a spiral, joining tangents *A B* and *B C*, and gradually increasing in curvature from *A* to *C*. The triangle *A B C* must, then be isosceles, and *A B* equal to *B C*.



Can these tangents be so joined by a curve gradually increasing in curvature from *A* to *C*, or by *any* curve which is not symmetrical with respect to *B D* as an axis? *B D* being a line intersecting the angle *A B C*. S. E. REAUGH.

TECHNISHER VEREIN, Secretary's Office,
287 BROADWAY, NEW YORK, Oct. 16, 1882.

EDITOR ENGINEERING NEWS:

The members of the Technical Society of New York, at their annual meeting on Oct. 14, 1882, elected the following officers for the year 1882-3: President, Dr. H. Endemann; Vice-President, Hugo B. Roelker; Corresponding Secretary, Max C. Budell; Recording Secretary, Hermann Rassbach; Treasurer, Paul Goepel; Librarian, Geo. W. Wundram.

At the close of the year 1881-82 the Society's list of members shows 187 active members.

A complete annual report on the Society's working and progress during the past year is in preparation, and will be issued shortly.

Very respectfully,
MAX C. BUDELL, Secretary.

REFORM NEEDED IN STANDARD GAUGE ROLLING STOCK.

PONTIAC, Ill., Oct. 23, 1882.

EDITOR ENGINEERING NEWS:

The railroad interest in the United States is very large, being represented by 104,000 miles of railroads, costing about $35,000 per mile, equal to $3,640,000,000. Any improvements in any part of this vast property that would tend to lessen the cost of transportation, would be welcomed by the owners of the roads and the public. Railroad directors, railroad officers, engineering journals, master mechanic, master car-builder, civil and mechanical engineering societies have been discussing the evil of our railroads hauling so much dead weight for several years. So far, however, no effective remedy worthy of the name has been applied. Competition with the lakes, rivers, canals and narrow-gauge roads, will compel the standard-gauge roads to reduce the dead weight of their rolling stock by increasing the load carried per car. In 1881 the 104,000 miles of railroads in the United States earned $725,000,000, or nearly $7,000 per mile.

The average cost of running a standard gauge train one mile is about 95 cents. This would give 4,568 trains run over the mile in both directions per year, and about 30 per cent. of these would be passenger trains, or say 1,356 trains per year, giving two daily trains each way for 339 days in the year, costing $1,288.20, and leaving 3,212 trains, costing $3,051.80, to do the freight business of that mile. The estimate, in each case, will be made for one mile of road. If we assume that 60 ft. per mile is the average limiting grade of our roads, and that the average weight of standard-gauge engine and tender is 60 tons, with 30 tons on driving-wheels, the gross weight of train that such an engine could haul would be 350 tons, composed as follows: 18 cars weighing 180 tons, load 162 tons, tender 8 tons. Then the weight of train, including engine and tender, would be 410 tons. This would be the train load in the direction of the heavier traffic, and the number of tons hauled per year over the mile by 1,606 trains would be 260,172 tons.

In the opposite direction the average paying load would be one-third as much, or 54 tons, and the gross weight of train would be 18 cars, weighing 180 tons; caboose car, 8 tons; load, 54 tons; engine and tender, 60 tons; all, 302 tons; so that the number of tons hauled during the year in the direction of the lighter traffic by 1,606 trains would be 86,724 tons, making the entire number of tons of paying load hauled in both directions during the year 346,896, and the dead weight of train hauled during the year in both directions over the mile would be 603,856 tons; and if the engine and tender be included the dead weight would be 796,576 tons. This gives 2.35 tons of non-paying load hauled for every ton of paying freight. This gives an average car load of paying load in both directions of 6 tons; that is, a car that has a capacity of 10 tons gets only 0.9 of a load in one direction, and 0.3 of a load in the opposite direction. This seems a very small average car load, but the average car load of the Chicago & Alton Railroad for all the cars loaded, partly loaded and empty, in regular freight traffic, was only 6.46 tons in 1877, and the C. & A. R. R. has been one of the best managed roads in the country during the last 18 years. This gives the cost of hauling one ton of paying load over one mile equal to .88 of one cent, and the cost of hauling paying and non-paying load would be nearly .27 of one cent per ton per mile. So that the standard-gauge roads pay $987 per mile per year for hauling 816,896 tons of paying load, and $2,115 for hauling 796,576 tons of dead weight. This looks as if the standard-gauge roads need reforming their needlessly heavy rolling stock. The standard-gauge freight car can be made strong enough, at a cost of $70 per car, to carry two tons of paying load for every ton of car, or a car weighing 10 tons can safely carry 20 tons. When the standard-gauge rolling stock is improved, a standard-gauge freight train in the direction of the heavier traffic will consist of 12 cars weighing 120 tons; caboose car, 6 tons (the weight of caboose should be reduced to 5 or 6 tons); paying load, 224 tons; and engine and tender 60 tons, all making 410 tons. Then the number of trains needed to haul the 260,172 tons in the direction of the greater traffic will be 1,162, and the same number of trains will run in the opposite direction, hauling the 86,724 tons, making the whole number of freight trains needed to haul the 346,896 tons in both directions, 2,324, thereby saving the cost of running 888 freight trains over the mile, and reducing the number of freight cars one-third and the number of freight engines 27 per cent., and the cost of fuel, oil, waste, water and engine repairs, 27 per cent., and the wear and tear of track in the same proportion. The number of passenger trains can not be reduced by reducing the weight of passenger coaches, sleeping cars, baggage and express cars; but the weight of passenger engines can be reduced and this will effect nearly as great a saving as a reduction in the number of trains. The total cost of running a standard-gauge train one mile has been estimated at 95 cents; but, in fact, only about 60 per cent. of this is spent in the actual running of trains. The other 40 per cent., or 38 cents per train mile, being consumed in expenses that remain the same whether the business of the road is light or heavy, and does not change with the amount of business done or the number of trains run. The items of expense that change with the number of trains run are as follows: Maintenance of way, 18 cents; fuel, oil, waste, water and engine repairs, 19 cents; car repairs, 9 cents; engineer, fireman, conductor and brakemen, 11 cents, and other items that do not change with the number of trains run, 38 cents; all making 95 cents per train per mile. The standard gauge road would save $506.16, or say $500, per mile per year by reducing the number of freight trains 888. This would reduce the operating expense per mile per year from $4,340 to $3,833.84, and increase the net earnings from $2,660 to $3,166.16, making the interest on $35,000 equal to 9 per cent. instead of 7½ per cent. $500 per mile per year is a large amount to waste in hauling needless rolling stock over the road. There is also a necessity for a reformation in locomotive construction. The weight on the driving wheels of locomotives is, in many cases, too much, and the rigid wheel base too long. Long, heavy trains are profitable, but there should be a limit somewhere. That limit is reached when the damage done by the engine to itself, and the cars that it hauls, and the track on which it runs, exceeds the profits derived from hauling long, heavy trains. The intelligent master mechanic knows how to build a good locomotive, but he does not always know whether it is more profitable to use an American engine with 44,000 lbs. on 4 drivers, or a mogul engine with 65,000 lbs. on 6 drivers, or a consolidation engine with 90,000 lbs. on 8 drivers with 15 or 18 ft. rigid wheel base. Nor does the master car-builder know whether it is more profitable to build a car to carry 10 or 20 tons. Master mechanics and master car-builders perform their duties, but they have not the authority and not always the qualifications to do what is for the best interest of their roads. That authority is vested in some official higher in authority. There is also another improvement that is much needed and neglected on many roads. Of roads built 20 or 30 years ago, many climbed over and wound around hills and bluffs that now reduce their efficiency. These obstructions should be reduced on roads doing considerable business, thereby increasing the carrying capacity 20 to 40 per cent. and the net earnings $500 to $1,000 per mile per year. Also the consolidation of several small struggling corporations under an efficient and intelligent general management would save two per cent. of the operating expense, and also insure the much needed improvements in rolling-stock and road. A large amount of capital thinks it sees a remedy for the evil of dead weight in the narrow-gauge railroad, and in consequence large amounts of money have been lately invested in building such roads, with what success remains to be determined.

In 1881, the 104,000 miles of railroads in the United States, costing $35,000 per mile, earned nearly $7,000 per mile, and spent in operation 62 per cent., or $4,340 per mile, leaving $2,660 net, or 7½ per cent. on the capital invested. A narrow-gauge railroad, with the same grades and relative curves, and with rolling-stock sufficient to do a business of $7,000 per year per mile, can be built for 85 per cent. of the cost of a standard-gauge road, or $29,750 per mile, saving $5,250 per mile, and this at 6 per cent. would give the narrow-gauge road an advantage of $315 per mile per year over the standard-gauge road.

Allowing that the expense of operation that does not change with the amount of business done or number of trains run is the same on the narrow-gauge road as on the standard-gauge road, then the cost of running a narrow-gauge train per mile would be as follows: Maintenance of way, 9 cents; fuel, oil, waste, water and engine repairs, 12¾ cents; car repairs, 6¼ cents; engineer, fireman, conductor and brakeman, 11 cents, and other items of expense that do not change with the number of trains run, 28½ cents; all making 67¾ cents per train per mile. The cost of running trains differs largely on different roads and in the different parts of the country, but 95 cents is a fair average for the standard-gauge roads and 67¾ cents per train mile is a fair average cost of narrow-gauge as compared with the cost of a standard-gauge train mile. The average narrow-gauge engine has only half the hauling capacity of the standard-gauge engine, and allowing the weight of narrow-gauge freight cars to be about 4¾ tons each, and that it can carry two tons of paying load for every ton weight of car, but gets only 9-10 of a load in the direction of the heavier traffic, then the narrow-gauge freight train will consist of 13 cars, weighing 61 tons; caboose car, 4 tons; and load, 110 tons, and engine and tender, 30 tons; all making 205 tons for the gross weight of train. Then the number of trains needed to haul the 260,172 tons of paying load in the direction of the heavier traffic will be 2,365, and the same number of trains running in the opposite direction will haul the 86,724 tons of freight in the direction of the lighter traffic. The number of narrow-gauge freight trains needed to haul the 346,896 tons on the narrow-gauge road would be 4,730; at 39¼ cents per train per mile would be $1,856.52. The 3,212 standard-gauge freight trains at 57 cents per mile cost $1,830.84. This gives the standard-gauge road a saving of $2,568 per mile per year in freight traffic more than the narrow-gauge road, but the narrow-gauge road saved $315 in construction and $369.51 in running 1,356 passenger trains, all making a total saving in favor of the narrow-gauge road, in construction and passenger traffic, of $684.51; from which deduct $2,568 saved by the standard-gauge road in freight traffic, leaving a balance of $658.83 in favor of the narrow-gauge road in construction and operation. This proves that the narrow-gauge roads are not to be despised as competitors for freight and passenger traffic. The standard-gauge roads with their freight cars improved can carry the 346,896 tons of freight in 2,336 trains, at 57 cents per train per mile, at a cost of $1,313.52, saving $543 per mile per year more than the narrow-gauge from freight traffic; from this sum must be deducted $315 saved by the narrow-gauge road in construction, and $369.51 saved in passenger traffic, all making $684.51, leaving a balance of $141.51 in favor of the narrow-gauge road from construction and operation over the improved standard-gauge road.

This is conclusive evidence that the standard-gauge roads must reduce the non-paying weight of their freight and passenger cars; otherwise, the narrow-gauge roads will increase in number and length. Capital will be invested where it can receive the largest returns. All these improvements add to the net earnings of the roads and lessen the cost of transportation to the patrons of the roads. The owners of railroad property, business men, producers and consumers are all interested in a reduction of the cost of transportation, and will encourage any means adopted to secure that end.

Civil Engineer.

BOOK NOTICE.

"Practical Farm Drainage and the Manufacture of Drain Tiles." By C. G. Elliott and J. J. Billingsly. Indianapolis, Ind. Price, $1.00.

We can recommend this little book as a most useful aid to those interested and engaged in farm drainage. It addresses non-professional men, and gives the principles that govern scientific drainage, in clear and plain language, illustrating them by numerous wood cuts in a manner that cannot fail to make the subject comprehensive even to the practical agriculturist. But the book will also be of use to engineers who are either to lay out works for the manufacture of tile pipe, or for draining a section of land, because it gives the most advanced principles and approved methods on both subjects.

Part I. treats on the mechanical and chemical effects of drainage in different soils with different contour both of surface and subsoil; it describes how to level for and lay out the drains, and discusses their depth, sizes and other details of the work with reference to different conditions. One idea advanced, concerning the location of submains and branches, we, however, cannot indorse. A calculation of cost will show that the usual system of parallel branches, discharging into a main from both sides, is *more* economical and just as effectual as the method preferred by the author, of running them parallel with the main and discharging into the latter by submains in the manner shown by the illustrations.

Part II. discusses the selection and preparation of clays for the manufacture of tiles; the best location for and arrangement of the factories, as well as giving numerous illustrations of kilns, mills and other machinery. Good practical advice is given on the selection of the entire outfit and also on the manipulations in pressing, handling and setting of tiles in the drying shed and kiln, and in burning them. The book closes with useful hints concerning the economy of the business.

ENGINEERS' SOCIETIES.

LIVERPOOL ENGINEERING SOCIETY.

At the meeting of this Society at the Royal Institution, Colquitt street, on Wednesday evening, 11th inst., Mr. F. B. Salmon, president, in the chair, a paper on "Some Recent Progress in Electrical Engineering" was read by Mr. I. S. Brodie, M. Inst. M. E. of the City Engineers Department. The paper described leading types of dynamo-electric generators, including those of Siemens, Gramme, Brush and Lachaussée, discussing the merits and comparative efficiency of each for the production of electric currents. The secondary batteries of Planté, Faure and DeMintins were next illustrated and described. Passing to the subject of the electrical transmission of power, the electrical railway of Siemens at the Paris exhibition was explained and illustrated by diagrams. An interesting discussion followed. We understand that a supplement to the paper on "Electric Lighting" will be read at the next meeting of the Society on the 25th inst., by Mr. Brodie.

ENGINEERS' CLUB OF PHILADELPHIA.

Rooms No. 1,523 Chestnut Street,
Philadelphia, Pa., Oct. 7, 1882.

The first meeting of the season was held this evening, President Rudolph Hering in the chair; 23 members and 5 visitors present.

Mr. W. H. Cory, of England, read a paper upon the subject of his process for the utilization of waste dust coal, which consists of mixing the coal with a small percentage of fine, dry fire-clay and another small percentage of silicate of soda, and submitting the block to a pressure of one ton to the square inch. The blocks are then stacked to dry, and in 24 hours (the chemical action of the alumina in the clay having converted the silicate of soda into silicate of alumina, or into an insoluble substance, in that time), the blocks are fit for use, and are as hard as ordinary coal. Among the advantages claimed for this fuel are the following: 7 per cent. more work than ordinary lump coal, there being no loss from dust falling through the fire-bars, etc.; that the fuel manufacturer can make his own silicate at little expense and trouble; that the fuel, being compressed, will stow in a much less space than coal; that it does not smoke, smell, decrepitate in the furnace or cause clinker; that the machinery is light and inexpensive; that the cost of manufacture will not exceed 50 cents per ton, and that all descriptions of coal can be utilized, without deteriorating their burning qualities. Mr. Cory exhibited samples made from anthracite, bituminous, and lignite coals, and concluded by giving statistics showing annual waste of coal in dust, etc.

The Secretary presented from Mr. H. M. Geer, a discussion of that part of Mr. P. H. Baermann's recent paper upon the "Thickness of Cast-Iron Pipe under Pressure" (Vol. III., 2, p. 109), wherein he refers to the rupture of a 12" pipe by the ram upon the sudden closing of a 2½" opening, under 230' head, by the breaking of a hydrant. For Mr. Baermann's formula, $\frac{W v^2}{2 g}$ (W = wt. of water in motion, v = velocity in feet per second, and g = acceleration of gravity) giving a pressure of 2,330 lbs. per sq. in., Mr. Geer substitutes $\frac{W v^2}{2 g} = P s$ (P = force or resistance, and s = space over which P acts) or $P = \frac{W v^2}{2 g s}$ and obtains, assuming that the moving mass of water is brought to rest with a uniformly retarded motion, in one second 1,354 lbs. per sq. in., in one half-second 2,708 lbs. per sq. in., and so on, inversely as the time. Without knowing the actual time of the closing of the valve and velocity of water, he considers deductions impossible. He refers to the reasoning of Mr. Fanning (Water Supply, p. 449) in this connection, as likewise erroneous. He attributes the cause of failure to thin, chilled, and imperfect pipe, and the general safety of pipes from effects of the ram to the existence of air-chambers at summits of undulations, the possible reflux of water to the reservoir, the compressibility of the yarn in the joints, and perhaps to the elasticity of the walls of the pipe, and the compressibility of the water itself.

The Secretary presented, for Mr. Howard Constable, a description of the Kinzua Viaduct, the highest bridge structure in the world, illustrated by numerous general and detail drawings and photographs. It forms part of a branch of the Erie Railway, into the coal-fields of Elk County, Pa., and its construction was found to be the most economical way of crossing the Kinzua gorge, a long-time obstacle in the way of railroad construction.

Surveys and investigations leading to the conception of this work were made by Mr. O. W. Barnes, Chief Engineer of the road before it passed into the hands of the Erie Railway. It was built according to Erie specifications, by Messrs. Clarke, Reeves & Co., under Mr. O. Chanute, Chief Engineer, assisted by Messrs. Chas. Pugsley, H. C. Keifer and the author. It contains 3,500,000 lbs. of iron, and cost $275,000. The paper describes the work very completely, and concludes with the following table of data:

DATA.

Total length of viaduct	2,052 ft.
Height of rail above stream	301 "
Number of towers	20
Height of iron work of lowest towers	16 ft.
" " highest "	278′3″.
Length of girders over towers	38¼ ft.
" " between "	61 ft.
Width of towers at top	10 ft.
" " bottom	10 ft. + ⅙ of height.
Live load "Consolidation" engines in any position. Equal on each tower of top	76,500 lbs.
Dead load on top of each column	22,650 "
" " each story, per column, about	5,000 "
Girders, calculated for a train of "Consolidation" engines.	
Chords strained in tension per sq. in. of net section	8,000 "
Chords strained in compression, per sq. in. of gross section	7,000 "
Diagonals strained per sq. in. from 5,000 to 7,000	
Rivets " " " 5,000	

WIND PRESSURE.

Maximum compression. Structure loaded.	
Pressure assumed at the top of each bent	20,000 lbs.
Additional pressure at each story of tower	1,000 "
Maximum tension. Structure unloaded.	
Pressure assumed at top of each bent	15,000 lbs.
Additional pressure at each story of tower	3,300 "
Strains allowed on "Phœnix" columns, of the length used (16 to 33 ft.), with an ultimate strength per sq. in. of	35,000 lbs.
Maximum compression from live load per sq. in.	7,000 "
" " " wind pressure per sq. in.	10,000 lbs.
Greatest strain for combined loads per sq. in.	8,000 "
Maximum tension on diagonals (rods) "	15,000 "
" strains on struts "	2 to 3,000 "
" tension on anchor bolts "	12,000 "

HOWARD MURPHY,
Secretary and Treasurer.

CENTRAL ASIAN RAILWAYS.

If the Russians have shown themselves poor in carrying out schemes for the improvement of their means of communication in Central Asia, they have certainly not done so in bringing forward suggestions on the subject. No Central Asian railway yet exists, but another suggested route has been sketched out, and has received a certain amount of official patronage and support. M. von Schultz, an engineer of some repute, recently made a survey of the Orenburg steppe by order of Gen. Struve, perhaps the foremost of living Russian geographers, and his report has just been laid before the Russian Geographical Society. According to this authority, the best line for a railway would be by the Ilek Valley, which lies considerably westward of the ordinary caravan route beyond Orsk. After leaving the Ilek, some distance above the Fort Ak Tinbé, the projected line would cross the Mugodar range of hills, and, following a due south-easterly course, reach the Aral at Tetsebash Bay. From Tetsebash Bay, Kazalinsk, or Fort No. 1, can be easily reached—the whole distance from Orenburg being little more than 500 miles. But the principal advantage of this route consists in its being better watered and more thickly peopled than any other across the steppe. Considering that it is not only the most direct route beyond Orenburg, but that it is also watered for a great portion of the journey by the Ilek and Emba streams, it appears strange that this particular route has not been brought more prominently forward. However, as it has now received such excellent official approval, it may be expected at the least to receive as favorable consideration as any of the other schemes brought forward for improving the means of communication between Russia and Turkestan. There is one point in connection with this scheme that marks it out as distinct from all others, and this is that it would be a Central Asian railway pure and simple. Every other plan that has been brought forward has claimed for its principal merit that it would connect the Central Asian dependencies with the great Siberian system of the future.—*London Globe.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

ANALYSES of water from the vicinity of Hamilton, O., have been made for the purpose of selecting a site for water works.

PRICE OF GAS IN MISSISSIPPI.—The Meridan Gas Company charges $3 per thousand.

SELMA, Ala., has 60 artesian wells.

WATER FOR GALVESTON, TEX.—There are no water works at Galveston at present. A part of the water for the city is obtained from cisterns and the rest is brought in on the cars from Highland Lake, some 15 or 20 miles distant. Galveston is most certainly in need of a bountiful supply of water. Many schemes have been discussed, but, as yet, nothing has been done toward building any one.

THE new water main of Bayonne City, N. J., will be connected with the Jersey City system to-day.

ELECTRICITY.

DULUTH, MINN., has an electric light and power company.

THE TIME TELEGRAPH COMPANY, of this city, has filed articles of incorporation. Capital, $1,000,000.

THE Evansville, Ind., electric light works are in full working order.

STREETS, DRAINAGE, ETC.

THE compressed asphalt block pavement laid on Michigan avenue, Chicago, three years ago, is being removed, in order that the street may be paved uniformly throughout, as required by ordinance. An examination of the blocks as removed shows that it is practically as perfect as when laid.

RIVERS AND HARBORS.

LEVEE.—The work on the cross levee just north of Quincy, Ill., is nearly completed.

LEVEES IN LOUISIANA.—NEW ORLEANS, Oct. 26.—State Engineer Sidney F. Lewis has just returned from a prolonged tour in Carroll and Madison parishes, where he has been engaged in surveying and taking out levees to be built by the Mississippi River Commission. He has just completed the lines for a succession of levees from Bedford to Delta, a distance of five miles of important river front, and he is having his notes put in order so as to turn them over to the United States engineers. He reports that the United States contractors are in many places already at work, and have their camps established and their plant of apparatus and working machinery on the ground. There is good progress all along the lines of levee to be built. The same may be said of the State contracts, and, with a fair season and no unusually early floods, Louisiana stands a good show of having efficient protection from the inroads of the river. A large camp of penitentiary convicts, under the care of the contractors, is established at Bonnet Carre, and the work of rebuilding the broken banks there is about to commence. The levee to be built there will embrace 240,000 cubic yards of work for a distance of nearly a mile, at a height varying from 5 ft. to 25 ft., the latter in the deepest places.

RAILROADS.

WORK on the Buffalo extension of the Rochester & Pittsburgh road is progressing remarkably fast. Twenty-six miles are already graded and ready for the ties, while a force of 450 teams and 2,000 men are at work on the remainder of the line.

FIVE ENGINEERS are at work making a preliminary survey of the proposed extension of the Boston, Concord & Montreal Railroad to Colebrook.

THE TRACK of the Utah & Northern has reached Race Track Creek, 8 miles from Deer Lodge.

R. R. WORK IN FLORIDA.—The work on the Jacksonville & St. Augustine Railroad is being vigorously pushed to completion. All the grading has been finished, and there are on the several sections of the road about 200 hands at work. About 50,000 ties have been cut and distributed along the line of the road. The wharf opposite Jacksonville has been completed. The entire road will require about 1,600 tons of steel rails, all of which has been ordered. Two locomotives have been contracted for.

THE directors of the New York, New Haven & Hartford Railroad have prepared plans for a thorough reconstruction of the road.

THE last rail of the extension from Goshen to Benton Harbor, on Lake Michigan, was laid on the 24th.

The Kankakee & Southwestern Coal Branch Railroad has been completed. The road runs from Buckingham, Ill., to Essex, Ill., a distance of nine miles. Work is being pushed on the Bloomington extension of the Kankakee & Southwestern. One hundred teams and 200 men are now at work.

GEORGIA PACIFIC.—A recent report relative to the state and progress of work on the line from Atlanta to Columbus states that from Atlanta to Anniston, a distance of 105 miles, the track has been laid with steel rails over 60 miles, and is being laid westward toward Anniston on the remaining distance at the rate of over half a mile a day. Tracklaying eastward from Anniston began on Monday, Oct. 2, and the gap between the latter place and Atlanta will be closed and trains running in November. From Birmingham to Anniston the work has all been let to contract, the contractors are on the ground with heavy forces, and the work is to be completed by August, 1883. This section embraces the heaviest work on the road from Atlanta to Columbus. Between Atlanta and Anniston there is one tunnel a little over 500 ft. long, which has just about been completed, and between Anniston and Birmingham is one tunnel of 700 ft., upon which work has just commenced. From Birmingham westward to the western boundary line of Walker County the line has not been located, and surveys are still being made with reference to the best route and the tapping of the marvelously rich coal deposits in that region. It is almost certain the whole line from Atlanta to Birmingham and from Columbus eastward to the Walker County line will be completed by August 1, 1883. This will leave a gap of only about 60 miles, and manifestly it will be to the interest of the railway to fill this gap as speedily as possible; and it is the hope and purpose of the company to complete this 60 miles by January, 1884.

ARTICLES OF ASSOCIATION of the Chicago, Indiana & Ohio River Railroad Company have been filed with the Secretary of State of Indiana. The line will run from Hammond, Lake County, to Terre Haute.

THE "NICKEL PLATE" road has been sold to a syndicate. The price paid was 37 for the preferred and 17 for the common stock of the company. The company, which built the New York, Chicago & St. Louis Railway, was organized in April, 1881, but the road was only opened for traffic on last Monday with a full equipment in every respect. The length of the road, which runs from Buffalo to Chicago by way of Cleveland and Fort Wayne, is 521 miles. The name "Nickel Plate" was given it in the slang of Wall street because the initial letters, N. Y. C. and L., of New York, Chicago and St. Louis, pronounced rapidly make the sound of the word "nickel."

RESIGNATION OF A RAILROAD MANAGER.—CHEYENNE, Wy., Oct. 26.—Robert Law, the well-known railroad manager, has resigned the superintendency of the Union Pacific Railway system in Wyoming, Utah, Idaho and Montana, to take the general superintendency of the roads in Iowa, Illinois and Missouri belonging to the Chicago, Burlington & Quincy Railway Company. Mr. Law is one of the best railroad managers in the West, and his loss will be seriously felt by the Union Pacific Company.

BRIDGES.

BRIDGE PLANS COMPLETED.—Plans and specifications for the bridge of the Highland Junction Company, across the Hudson River at Cornwall, have been finished.

THE RAILROAD BRIDGE at Yazoo City, Miss., must be completed, according to contract, by the first of January.

THE GREAT BRIDGE over the Missouri River at Bismarck, was tested last Saturday, and found perfect.

THE ROCK RIVER BRIDGE, at Moline, Ill., is progressing slowly. It is expected that the bridge will be fully completed by Nov. 1.

BUILDING.

PIPE-STONE CITY, MINN., will build a $10,000 schoolhouse.

DUBUQUE, Ia., is having a building boom. Seventy-nine buildings have been erected since last March.

LABOR.

THE bricklayers at Laredo, Tex., are on a strike for $5.50 per day.

CANALS.

THE Hennepin Canal survey party has reached Annawan, and will come out at a point near Port Byron. They will finish the survey this week.

TUNNELS.

THE CHANNEL TUNNEL SCHEME.—LONDON, Oct. 13.—The committee under Gen. Sir Archibald Alison, appointed to report on the channel tunnel, consider that the exit of the tunnel should be commanded by a fortress of the first class; that the tunnel should also be provided with a portcullis, and with an arrangement for filling it for a sufficient space with an irrespirable gas, and that measures should be taken for the demolition of the land portion of the tunnel, for the temporary flooding of the main tunnel, and also for its total destruction by mines. These arrangements should be controlled by separate parties both inside and outside of the commanding fortress. When all this is done, the committee admit that it would be presumptuous to place absolute reliance upon even the most comprehensive arrangements. Memoranda from Gen. Sir Garnet Wolseley and the Duke of Cambridge, the Commander-in-Chief of the Army, are appended, even more strongly condemning the tunnel. The *Times* considers that this report has settled the question of the tunnel adversely for a long time to come.

LITERATURE.

"POTABLE WATER, and the Relative Efficiency of Different Methods of Detecting Impurities," by Chas. Watson Folkard, is No. 61 of Van Nostrand's *Science Series*, just reprinted from the paper read before the Institution of Civil Engineers, where it was considered worthy of considerable discussion.

THE *North American Review* for November presents an unusually diversified Table of Contents. "English Views of Free Trade," by the Hon. John Welsh, of Philadelphia, is a clear and forcible exposition of the difference between the economic situation of England and that of the United States, and of the considerations which make Free Trade imperative for the former country, if she would retain her present position as the world's workshop. Joseph Neilson, Chief Judge of the Brooklyn City Court, writes of "Disorder in Court-Rooms," a subject of profound interest to good citizens at all times, and more especially now in view of certain recent occurrences. The *obiter dicta* of the learned author touching the Guiteau trial and the Lawson-Gray incident at Dublin, are characterized by the best judicial temper. Dr. Wm. A. Hammond, ex-Surgeon-General of the U. S. Army, offers "A Problem for Sociologists," the problem being to determine the degree of responsibility before the criminal law, of persons affected by certain forms of insanity. "The Industrial Value of Woman," by Mrs. Julia Ward Howe, is a very able reply to an article recently published on "Woman's Work and Woman's Wages." "Advantages of the Jury System," by Dwight Foster, formerly a Justice of the Massachusetts Supreme Court, will command the attention of every thoughtful citizen, being a grave and learned defence of an institution which it is becoming the fashion to belittle and decry. The remaining articles are "Safety in Theatres," by Steele Mackaye, the distinguished actor and theatrical manager; "The Pretensions of Journalism," by Rev. Geo. T. Rider, and a symposium on "The Suppression of Vice," by Anthony Comstock, O. B. Frothingham and Rev. J. M. Buckley.

CONTRACTING.

THE contract for laying an asphalt sidewalk on Fifty-ninth street, from Eighth to Fifth avenue, and on Fifth avenue from Sixtieth to Seventy-fifth street, has been awarded to the New York Mastic Works, 35 Broadway, New York.

COMPARATIVE STATEMENT RELATIVE TO THE CONSUMPTION OF WATER IN THE SEVERAL CITIES AS FOLLOWS:

YEAR 1881.	New York.	Brooklyn.	Boston.	Newark.	Providence.	Pawtucket.	Fall River.
Number of meters in use	6,500	1,208	1,385	186	5,129	1,500	1,900
Annual cost of repairs	Owner repairs meter.	$3,460	No figures	No figures.	No figures.	90c each.	Owner repairs meter.
Annual revenue	$1,600,000	924,316	$1,323,171	$307,539	$260,530	$35,000	$114,000
Population	1,300,000	560,000	415,000	138,000	104,850	40,000	50,000
Daily consumption in gallons	100,000,000	32,731,500	38,214,000	9,888,383	3,716,937	2,000,000	2,000,000
Daily average consumption through meter	15,000,000	3,550,500	4,512,750	No figures.	No figures	No figures.	No figures
Number of taps in use	85,000	62,000	60,000	11,902	10,745	2,629	3,050
Percentage of taps metered	7.65 per cent.	1.05 per cent.	2.30 per cent.	1.57 per cent.	47.74 per cent.	57.05 per cent.	62.29 per cent.
Percentage of daily consumption in gallons registered by meter	15 "	10.85 "	11.81 "				
Daily consumption in gallons per capita	76.92 "	58.44 "	92.08 "	71.62 per cent.	34.50 per cent.	50 per cent.	50 per cent.
Meter considered the best	Crown and Worthington.	Crown	Crown and Worthington.	Worthington.	Crown	Crown.	Crown.
Meter furnished by	Consumer.	Consumer.	City.	City.	Consumer,	Consumer.	Consumer.

Nov. 2, 1882.

Compliments PETER MILNE, JR., Water Purveyor, Brooklyn, N. Y.

CONSUMPTION OF WATER.

The above interesting table of water statistics has been carefully compiled from the very latest information, by the well known and capable Water Purveyor of Brooklyn, Mr. P. Milne, Jr., through whose courtesy we are enabled to present the same to our readers.

The wilful waste of water in affecting the taxpayers is now a matter of great and growing interest in every community. It is universally conceded that in the meter system lies the only remedy for this growing evil. The above table strikingly illustrates the advantages of meters in regard to revenue and consumption of water. The figures furnished by the Water Department of Providence are worthy of more than passing notice when compared in some of their features with the results obtained in other cities.

As a very strong evidence of the utility of the meter system, a comparison of the daily consumption of water and the revenue derived from it in Providence, where nearly 48 per cent. of the taps are metered, presents some interesting figures alongside of those shown from New York, Brooklyn and Boston.

Providence has a daily consumption of 3,716,937 gallons, from which it derives an annual revenue of $260,530. New York has a daily consumption of 100,000,000 gallons, from which it derives an annual revenue of $1,600,000, with not quite 8 per cent. of the taps metered. Brooklyn has a daily consumption of 32,731,500 gallons, with an annual revenue of $924,316, with a little over 1 per cent. of the taps metered. Boston has a daily consumption of 38,214,000 gallons, and an annual revenue of $1,328,171, with a little over 2 per cent. of the taps metered.

The point we desire to make is, that for the daily consumption of water in proportion to the number of inhabitants and the amount of revenue derived the city of Providence exemplifies in a marked degree the benefits of the meter system, and presents arguments in its favor in this respect that are seemingly unanswerable.

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CONTRACTING IN BRAZIL.

From the Rio News, Oct. 5.

The last specified period of the contract for the construction of the Rio do Ouro water-works of this city, that of the contractor's guarantee, expired on the 27th ult. According to the terms of the contract and to all the ordinary laws of business, the accounts should have all been settled and paid on that date, and the contractor discharged from all further liability. It is worthy of note, however, that nothing of this kind has been done. The cash sureties deposited by the contractor, are still retained by the government, no inventories have been taken, the final measurements have not been made, and not one single account has been liquidated. The claims against the government under this contract amount to about 1,500,000$ the greater part of which promises to be lost. Even payments on undisputed accounts are wilfully delayed. The contractor has been subjected to needless delays in the execution of his work, to the petty whims of government engineers, to extra expenses for which no allowances have been made, to extraordinary requirements for which payment is refused, to losses on materials required by the government which now declines to accept them except at a ruinous reduction, to fines, delays and annoyances of every kind and description. The Rio do Ouro tramway alone, which the contractor was compelled to keep up eighteen months over the time specified, has occasioned a loss of fully 400,000$, which the government engineers now decline to recognize. Even the small amount of 8,000$ expended in repairing damages after the rains of February and March last, at a time when the line was kept open simply for the convenience of the government, remains unpaid. The Pedregulho inclined plane, which was twice moved to suit the whims of the government engineers, leaves a loss of not less than 25,000$. Several branches of the work, notably that of the reservoirs, were carried out according to the plans and specifications of the government engineers, under their supervision, and then the contractor has been fined because of defective work. The contract guaranteed a premium to the contractor in case the introduction of water into the city was made before certain specified dates, and although the government engineers were decorated for this achievement, the contractor has been refused the premium. The personal prejudices of all the parties concerned, from the late Minister Buarque de Macedo down to the lowest subordinate, have been allowed to influence the execution of the contract and its liquidation. The only logical conclusion to be drawn from the matter is that the government has fully resolved to delay and refuse payment in every possible case. Men who are openly hostile to the contractor, through personal difficulties, are placed in official positions where all the expert reports and decisions must pass through their hands. Under such circumstances it is highly improbable that justice will be accorded in the settlement of these claims; it is even improbable that justice is intended. In this connection it is reported that the contractor, Mr. Antonio Gabreilli, has recently transferred all his claims to his bankers, who will hereafter press matters on the very substantial ground of cash advanced. It is to be sincerely regretted that this great enterprise has turned out in this way—either in a loss of credit to the government or a pecuniary loss to the contractor. However it may be settled, this one contract will hereafter be a stumbling block in the way of the government. No other contractor will knowingly place himself in a position similar to that just occupied by Mr. Gabreilli.

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ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, NO. 1523 CHESTNUT STREET,
PHILADELPHIA, PA.

OCTOBER 21., 1882.—Mr. Washington Jones was called to the chair. Fifteen members and two visitors present. Col. Livingstone, of Philadelphia, described the system of driven wells, giving various data and statistics with regard to results obtained in this and other localities.

Dr. H. M. Chance described several horse-shoe or ox-bow bends occurring in the streams of Western Pennsylvania, attributing the origin of each and every similar loop to synclinal axes.

Loops on the Allegheny River at Brady's Bend and at Scrubgrass (also an old abandoned loop at Parker, 200 ft above the present channel); on the Red Bank Bank Creek near Bethlehem; on Kettle Creek in Clinton County, and old abandoned bends at Callensburg on the Clarin River, and near Westport in Clinton County, were described, the inevitable synclinal axis present at all of them, affording the only explanation of their origin.

HOWARD MURPHY, Secretary and Treasurer.

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BIDS FOR DOCK DEPARTMENT WORK.—The Dock Commissioners on the 2d inst. opened bids for department work. The Union Dredging Company was the only bidder for dredging at the foot of East Twenty-fourth street, and at the dumping boards on Pier No. 61 East River, at the foot of East Seventeenth street, East Twenty second street, and West Forty-seventh street. The estimate was 27 cents per cubic yard at the foot of East Twenty-fourth street and 30 cents per cubic yard for the remainder of the work. John Gillies' bid of $14,706 was the lowest for repairing the pier at the foot of East Fifth street, and Moses Engle's bid of $5,975, the lowest for repairing the bulkhead at the foot of East Seventeenth street. Through a clerical error, James D. Leary bid $5,990 for the larger job and $15,990 for the smaller. The Commissioners, however, were compelled to accept the former bid, and he was given notice to that effect.

IMPROVEMENT OF THE UPPER MISSISSIPPI.

The following are abstracts of proposals received and opened by Major A. Mackenzie, Corps of Engineers, U. S. A., Rock Island, Ill., at 2 p. m. Sept. 23, 1882:

Abstract of Proposals for dredging at Dubuque, Iowa.

Names of Bidders.	Residence.	Price per cu. yd. for Dredging.
		Depositing at a distance not exceeding one mile.
H. S. Brown	Quincy, Ill.	23
H. Fox & Co.	Chicago, Ill.	24
B. E. Linehan	Dubuque, Ia.	19¾
A. J. Whitney	Keokuk, Ia.	22

Abstract of Proposals for dredging in Quincy Bay, Ill.

Names of Bidders.	Residence.	Price per cu. yd. for Dredging.	
		Depositing at a distance not exceeding one mile.	Depositing at a distance not exceeding two miles.
H. Fox & Co.	Chicago, Ill.	21	23
H. S. Brown	Quincy, Ill.	20	22
A. J. Whitney	Keokuk, Ia.	21½	23¼
B. E. Linehan	Dubuque, Ia.	21¾	23

Abstract of Proposals for constructing dams and shore protections of brush and stone between Mt. Vernon, Minn., and Fountain City, Wis.

Names of Bidders.	Residence.	Brush.	Stone.
		Per cu. yd.	Per cu. yd.
J. Richtmay	Ft. City, Wis.	95	1.45
S. J. & A. H. Truax	Hastings, Minn.	1.10	1.75

The above prices include all cost of furnishing and putting in the dams, etc., brush and stone.

Abstract of Proposals for constructing dams and shore protection of brush and stone between Homer, Minn., and Queen's Bluff, Minn.

Names of Bidders.	Residence.	Brush.	Stone.
		Per cu. yd.	Per cu. yd.
S. J. & A. H. Truax	Hastings, Minn.	98	1.40
S. D. Van Gorder	Winona, Minn.	1.40	1.85
P. S. Davidson	La Crosse, Wis.	95	1.35

The above prices include all cost of furnishing and putting in the dams etc., brush and stone.

Abstract of Proposals for completing dams and shore protections of brush and stone between La Crosse Bridge, Wis., and Brownsville, Minn.

Names of Bidders.	Residence.	Brush.	Stone.
		Per cu. yd.	Per cu. yd.
P. S. Davidson	La Crosse, Wis.	85	1.25
S. J. & A. H. Truax	Hastings, Minn.	1.10	1.75
D. A. McDonald	La Crosse, Wis.	92	1.53

The above prices include all cost of furnishing and putting in the dams, etc., brush and stone.

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THE hydraulic pumps at the Combination Shaft on the Comstock lode are now raising 2,000,000 gallons of water daily, which is discharged through the Sutro Tunnel. This amount of water weighs 8,333 tons. The pumps raise the water 800 ft. at one lift. To operate the pumps requires 1,000,000 gallons of water per day, having a head of 2,830 ft. perpendicular, conducted from the Virginia & Gold Hill Water Company's reservoir through an 8-inch pipe to the 2,400-foot level of the mine, where the pumps are situated.

IMPROVEMENT OF THE POTOMAC FLATS.

Bids were opened last Monday by Colonel Peter C. Hains, U. S. A., engineer officer in charge of the improvement of the Potomac Flats, Washington, D. C., to dredge out and deposit upon the flats 1,700,000 cubic yards of material. These bids were advertised for throughout the country, and at the appointed hour eight bids, from as many bidders, had been presented as required. Representatives of all the bidders were present, including Lieutenant Commander Henry H. Gorringe, U. S. N., (who removed the celebrated Egyptian obelisk from Alexandria to the Central Park in New York), who represented the American Contracting and Dredging Company, of New York city. All the bids were accompanied by securities to enter into bonds to perform the work if the contract was awarded to the bidder, and each one proposed to complete the number of yards mentioned in the advertisement by August 31, 1883. The bids were as follows: William H. Adams & Co., of Washington, 19½ cents per yard for the whole work, beginning by November 15, 1882, and using four dredges with a capacity of 10,000 yards a day; Rittenhouse Moore, Mobile, Ala., 27 cents above the Long Bridge and 21.2 below, two dredges, 5,000 yards per day; George C. Fobes & Co., Baltimore, 29 cents below the Bridge only; National Dredging Company, Washington, 34 cents above and 24 below the bridge, taking out 5,000 yards daily; American Contracting and Dredging Company, New York city, 24.75 cents for the whole work; H. W. Beard, Brooklyn, N. Y., 36 cents for all the work; Moore & Wright, Portland, Me., 40 cents above and 36 below the bridge, and Sanford Rose, Jersey City, 21.2 cents per yard for the whole work. The material is to be taken from the river, the Eastern Branch, and Washington harbor, and must be deposited inside of the bulkhead line to be established, thus necessitating the building of extensive tracks all over the flats, most of it on piles, and the employment of dirt cars and railway engines. It will thus be seen that the portion of the flats that is now marsh will be, on completion of the work, a perfect network of piling, to add solidity to the made ground.

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THE ELECTRIC LIGHT IN SHANGHAI.

The electric light has now been exhibited in Shanghai for nearly a month, and, judging by the gratifying enthusiasm which the subject has aroused among the Chinese, we may expect to see the new light spread throughout the settlements as fast as the company can furnish the necessary power. The Shanghai Electric Company having successfully raised their modest capital of 50,000 taels, and in doing so being compelled to reject nine-tenths of the applicants for shares, mainly Chinese, at once set to work to erect the dynamo-machine, the dispatch of which from America had been previously arranged. There are now 15 lamps working on the circuit; 4 at the China merchants' lower wharf, rented by the company for the purpose of illuminating their frontage and enabling work upon vessels lying alongside to proceed as easily at night as in the daytime. The light gives comparative immunity from robbery and danger. The number of deaths from drowning in the darkness used to average one a week. The Astor House has in its restaurant, billiard and bar rooms three electric lamps, whose brilliant lustre shining through the open windows attracts an admiring crowd of Chinese, who throng the road till past midnight. Sixteen lamps being the complement of the present machine, nothing more can be done to extend the light until the company's new 40-light machine is erected. The foundations for this and for the 40-horse-power engine with which it will be driven are now being rapidly constructed, and before the end of the month the company will be in a position to respond to the numerous applications for private lamps which are being daily made to them.—*North China Herald.*

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NEW BOOKS.

Die Calculation im Maschinenwesen. By A. Messerschmidt. Essen, Prussia, 1882. Price $1.00.

The design of this book is to furnish mechanical engineers and others engaged in the manufacture of machinery a ready means for estimating both the cost of various mechanical manipulations and the total cost of a machine.

Although the book is intended for German practice, many useful hints may be found in it for those of our readers interested in the subject. The principles and formulae advanced are illustrated by numerous practical examples.

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COLUMBUS, Ohio, Nov. 2.—The Redfield syndicate tonight signed the contracts with Stearns, Norris & Co. for building the Columbus & Eastern Railway east from this city for 60 miles to the Moxahala coal fields. The road is to be ready for cars Aug. 1, 1883.

ENGINEERS AND ENGINEERING IN OTHER LANDS.

[Specially translated and prepared for the ENGINEERING NEWS.]

A patent has been lately taken out by Dietrich, of Berlin, for an improved roller for asphalt pavements. A great deal of the durability of asphalt roads depends, it is said, on the uniformity of the pressure, which produces evenness of surface. The stampers are so arranged that no part of the road is passed over. The machine can be worked by levers, compressed air, etc. As an economical method for keeping pavements even it may doubtless be useful.

The Corinth Canal has now its monthly bulletin as well as its Panama prototype, and it has even a classical motto—"Licet omnibus adire Corinthum." As there is somewhat of a superfluity of great engineering projects just at present, the circular enumerates the advantages that navigation will derive from the cutting of the canal, and a total of 5,897,000 tons that will use the canal is summed up. The maritime movement of Constantinople in 1879 was upward of seven million tons; that of Greece upward of eight millions, and then the Italian ports, Marseilles, etc. The length is only 6,343 metres, and the contract price, including bridges, telegraphs, etc., 24,600,000 francs. Some 800 workmen are now employed, and 250,000 cubic metres per month will be excavated. Mr. Gerster is the chief engineer in Greece; he surveyed the Darien route in 1877. M. de Lesseps is, however, president of the Managing Board, although General Turr is the acting president.

A general survey of France will doubtless be soon begun: a vote of 500,000 francs was asked for by the Minister of Public Works, but the examining committee believed that it should take in the first place the form of a law. The French Etat-Major, M. Bourdalone (1857 to 1864) and the Ministry of Public Works (1878) have furnished excellent materials for the work. Thirty-four of the departments have voted 1,200,000 francs for the purpose, and the services of local engineers will be largely availed of. Some 7,000 persons will, in fact, be employed, and the expense is estimated at nearly 27,000,000 francs, from which the value of instruments already possessed by the state and the services of government employés must be deducted, leaving net cost of 19,0 0,000 francs. If the War Department, which has a general map on the scale of $\frac{1}{80000}$ in hand will combine its operations with the civil undertaking, a very remarkable work can be produced. It is proposed to somewhat popularize the results in the form of a graphic index, published in small sheets, each to include a commune, thus rendering great aid in laying out water-works, new roads, etc.

The state surveys of the different European countries are anything but complete, even at this late day. An interesting article in the *Genie Civil* gives a review of them from which we condense the following:

The Ordnance Survey of Great Britain was first begun in Ireland in 1824. The scale was $\frac{1}{10560}$ with level curves. The whole of Ireland and a portion of Scotland have been surveyed in this way. Initial leveling was first made by special operators, and each county was crossed by one or two lines at least. The parish maps are on a scale of $\frac{1}{2500}$, and the county maps on that of $\frac{1}{10560}$—these latter give the figures of the benchmarks in the buttes of a foot and the leveling curves. Only maps for one-third of England and two-thirds of Scotland are yet ready.

In Belgium levelings have been made by the Ministry of War, and the cadastre reduced to the scale of $\frac{1}{20000}$ serves as a basis for the plane tables, which are estimated by the triangulation. The planimetry is verified and completed with the greatest care on the ground by officers. The curves are printed in chromolithography on a scale of $\frac{1}{20000}$, and reductions at $\frac{1}{40000}$ in ordinary ink.

Switzerland is now nearly completely surveyed, and some very fine work has been done in the way of initial leveling. The Goldschmidt barometer is used for inaccessible parts. The scale is $\frac{1}{50000}$ for the high mountainous region and $\frac{1}{25000}$ for the remainder of the country. The surveys since 1868 have been undertaken by private parties, the remuneration being 35 francs per square kilometre for the latter scale and half that amount for the former. An engineer can do about 104 kilometres during a season. There are 112 maps on the small scale and 440 on the large scale. Some Cantons have begun surveys at $\frac{1}{5000}$ with horizontal sections, and reductions have been made on a scale of $\frac{1}{10000}$.

We find that in Germany there are three divisions, viz.: North Germany, Wurtemberg and Bavaria. The Prussian Etat Major is publishing maps on a scale of $\frac{1}{25000}$, and 320 out of 1,250 have been already issued. In Wurtemberg the work is undertaken by the royal commission for railway construction, and a scale of $\frac{1}{25000}$ has been adopted. 50 maps out of 713 are published. The Bavarian Etat-Major has published 78 maps out of the contemplated total of 901. The scale is the same as for Wurtemberg.

Denmark, though a very flat country, has undertaken a survey with leveling curves at an equidistance of ten Danish feet, and 35 maps out of 135 have been issued. The scale is $\frac{1}{20000}$.

The survey of Italy is yet in a backward state, only some 20 maps have been completed. The plane board, with a scale of $\frac{1}{50000}$, has been adopted.

A very careful survey is being made of Spain with curves at 20 metres. An initial survey, completed by a secondary and a network of crossings at distances of some 600 yards. The scale is $\frac{1}{25000}$. The work is under the direction of General Hanes.

The survey maps for Austro-Hungary will be on the scale of $\frac{1}{75000}$; the old maps were on that of $\frac{1}{144000}$. The equi-distance for curves varies from 100 metres in the mountainous districts to 20 and even 10 metres in level grounds, and to 5 metres in the vicinity of large cities. Some 270 sheets out of 720 have been published.

The relative purity of glycerine is of great importance to engineers, for now, owing to the great demand for the article and the higher prices, adulterations are often practiced. In addition to this want of care in manufacture, is the cause of many impurities remaining, among which are oxide of lead, lime and butyric acid. French perfumers test glycerine with nitrate of silver; if it does not become muddy or change color within 24 hours, it is considered as of good quality. The chloroform test is made by mixing equal parts of chloroform and glycerine, shaking them well and letting the mixture rest. The upper layer is pure glycerine; the lower is chloroform, but containing all the impurities; if there are none, the chloroform undergoes no change. By adding a few drops of sulphuric acid diluted with equal parts of glycerine and distilled water, and then with a little alcohol, the presence of lime or lead is indicated by a white precipitate. The lead can be demonstrated by a current of hydro-sulphuric acid. Butyric acid is tested for by mixing the glycerine with absolute alcohol and sulphuric acid at 66° Baumé; on gently heating, the acid will be recognized by its agreeable odor. Glycerine is often adulterated with sugar, glucose, dextrine and gum. They can be detected by mixing the glycerine with 150 to 200 drops of distilled water, adding 3 or 4 centigrammes of molybdate of ammonia and a drop of pure nitric acid, and then boiling for about 30 seconds. If the glycerine contains any sugar or dextrine the mixture turns blue. Glycerine adulterated with cane sugar or syrup, takes a brownish black color when boiled with sulphuric acid. Glucose is detected by boiling with caustic soda, when the mixture turns brown.

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CANALS.

THE idea of piercing the Isthmus of Malacca, which is a matter of considerable interest in France, is being actively pursued. The French Consul at Siam, Dr. Harmand, the celebrated explorer of the Indo-Chinese peninsula, has just surveyed the ground, with the co-operation of the King of that country, and has reported that the scheme is perfectly practicable. The King, it is stated, has expressed his willingness to make a concession to M. de Lesseps.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 373.)

CCCXCIX.—AMHERST, MASS.

Amherst, Massachusetts, in lat. 42° 20′ N., long. 72° 30′ W., is on the Connecticut River, in a rolling and rocky country.

Settled in 1721, it was incorporated in 1759. Amherst College was founded in 1821.

Water-works were built for a private company in 1879 by Goodhue & Birnie, after plans of Phinehas Ball, C. E., taking the supply from Mill River, a stream of about 3 square miles water-shed. A dam of stone masonry 150 ft. long, 19 ft. high, 8 ft. wide at top and 20 ft. at bottom, forms a storage reservoir of 1,000,000 gallons capacity at 150 ft. above the college, and 330 ft. above the lower part of the village, to which the water is conveyed by 20,000 of 12 in. cement-lined wrought-iron pipe. Distribution is by 12 miles of the same kind of pipe, of from 12 to 4 in. diameter, with 30 fire-hydrants, 32 gates and 200 taps. The fire hydrants are owned by the town, which pays $1,000 per year for public water. Service pipes are of lead.

The population in 1880 was 4,035. The daily consumption is not known.

The works have cost $60,000. There is no bonded debt. The amount to be paid for water damages is not yet adjusted. E. D. Bangs is the Superintendent.

CCCC.—GUNNISON.

Gunnison, Colorado, in lat. 38° N., long. 107° W., is on the Gunnison River, in one of the parks of the Rocky Mountains.

It was settled about 1870. Water-works were built in 1882 for a private company, by Carroll E. Gray, taking the supply from the Gunnison River, a swift mountain stream, draining about one square mile.

A stone and brick conduit conveys the water 2,000 ft. from the river to the engine-house, where it is pumped directly into the mains by two Worthington duplex steam pumps, of 1½ million gallons daily capacity each. The ordinary pressure maintained is 40 lbs., and the fire pressure 80 to 100 lbs.

Distribution is by 4 miles of cast-iron pipe, of from 12 to 6 in. diameter, with 45 fire hydrants, for which the city pays $1,300 per year. The number of taps is not given. Service pipes are mostly of iron, and some of lead.

The population, which in 1880 was 952, is now said to be about 4,500.

The Gunnison Gas & Water Co. has a capital stock of $200,000, and a bonded debt of $150,000 at 7 per cent. interest. The cost of the water-works is not given, nor the daily consumption. D. J. McCann is the Superintendent.

CCCCI.—HOT SPRINGS, ARK.

Hot Springs, Arkansas, in lat. 35° N., long. 93° W., is on a mountain stream in the valley between Sugar Loaf and Hot Springs mountains, of the Ozark range.

Settled in 1820, it was incorporated as a city in 1874. Water-works were built in 1882 for a private company by Carroll E. Gray, taking the supply from Bull Bayou, which receives the drainage of about ½ square mile of mountain slopes, and on which a reservoir is formed by a masonry dam across a narrow gorge in the rocks. The water is conveyed by a stone conduit 5 ft. high, for 40 ft. to the pumps, and is pumped by a Worthington duplex steam pump to a reservoir holding 1,000,000 gallons, excavated in rock on the mountain 262 ft. above the main street of the town. A high-pressure Worthington engine can pump directly into the mains for fire service.

Distribution is by 6 miles of cast-iron pipe of from 12 to 6 in. diameter, with 40 fire hydrants, 11 gates and 250 taps. The city pays $4,000 per year for hydrants. Service pipes are mostly of lead, with some of iron.

The population in 1880 was 3,000. The daily consumption is not given, nor any financial statistics. H. Moysley is Secretary, and J. H. McGlashen the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks: From D. S. Thomas, President and Superintendent, statistics and water rates of the water-works of Carthage, Mo. From A. M. Wheless, Superintendent, statistics and water rates of the water-works of Dallas, Tex. From L. F. Olney, C.E., statistics and water rates of the water-works of Middletown, N. Y. From F. F. Forbes and E. S. Philbrick, C.E., revised statistics of the water-works of Brookline, Mass. From Goodhue & Birnie, statistics of the water-works of Amherst, Mass. From Carroll E. Gray, Jr., statistics of the water-works of Hot Springs, Ark., and Gunnison, Col. From Oliver Ayers, Superintendent, statistics and water rates of the water-works of Portsmouth, N. H. From S. L. Wiley, statistics of the water-works of Owego, N. Y.

CORRESPONDENCE.

WHICH IS IT?

OMAHA, Nov. 1, 1882.

EDITOR ENGINEERING NEWS:

On page 177 of Trautwine's Engineering Pocket-book, edition of 1881, it is said in the twenty-third line from the bottom, "it is plain that there would be some load which would stretch a uniform bar to twice its original length, *or shorten it to zero or 0.*"

I wrote the author and showed to him why the last expression "shorten it to zero or 0" is wrong. Mr. Trautwine answered, and said I seemed "to have overlooked the fact that" he says, "If this were also the case beyond said limit." And finally expresses the hope that his letter "may serve to clear my mind on the subject." I wrote him that his explanation had no such effect whatever; and I claim that the expression, "or shorten it to zero or 0," is a mathematical failure and a practical absurdity which anybody may perform, but nobody insist upon. Engineers, what is your opinion on this?

J. E. CASTBERG, Draughtsman.

BROCK'S TRUSS BRIDGES.

340 SOUTH TWENTY-FIRST STREET, PHILA.,
Oct. 30, 1882.

EDITOR ENGINEERING NEWS:

In the interesting articles which have just been begun in your paper on "Truss Bridges," it is stated that all the information that remains of the earliest patents for bridges is the record of the names of the grantees and the dates. This is not true, since many are described in contemporary publications of the day, and as their early date makes them especially interesting, it would add greatly to the value of the articles if such descriptions were searched for and added. Illustrations of the bridges of Timothy Palmer and Thomas Pope, the patents for which were granted in 1797 and 1807, can be found in Pope's "Treatise on Bridge Architecture," published in New York in 1811, a rare work, of which you gave a description in the columns of your paper some years ago.

Respectfully yours, THOS. M. CLEEMANN.

[We are much obliged to Mr. Cleemann for the above suggestion, and we are glad that it came so promptly. It entails an amount of research on the part of Mr. Brock that he is really not able to give the time to now. But we hope that Mr. Cleemann and other engineers who are familiar with bridge literature will follow up Mr. Cleemann's suggestion and give to our readers the benefit of their present knowledge. The subject is an important one, and in this first venture into a new field of engineering research we invite liberal criticism and suggestion, so that our readers, who are the parties we are trying to please, may secure the greatest profit and satisfaction.—ED. ENGINEERING NEWS.]

THE MARKETS.

(From the Iron Age.)

NEW YORK, Nov. 1, 1882.

In most departments of general trade there is a dullness not readily accounted for, but there is a proneness to attribute any temporary feeling of disappointment to unseasonable weather, or the distraction caused by political discussion. Both in the city and country at large there is a slight decrease in the volume of traffic—manufacturing points alone excepted—as indicated by the Clearing House exchanges, and the freight movement by rail shows some falling off. From Chicago eastward shipments are increased compared with the previous week, but the official statement shows a decline of 20,620 tons, or 44 2-10 per cent. from the shipments of the corresponding week last year. Despite these indications the general prosperity of the country is in no degree abated; labor in every section is actively employed; in the absence of speculation business is done on a conservative basis, with close credits; and, withal, food supplies and other exportable commodities are abundant.

Money is easy at 4@6 per cent. on call; prime mercantile paper, 6@6½ per cent.; four months' acceptances, 6½@7 per cent.

Rails.—Some inquiry for steel rails is reported, but no new business. We quote steel at mill, $45@$46.

Old Rails.—Sales during the week include 500 tons D. H. at $30.50 and 1,600 tons old bridge rails, said to be at $28. Of Ts the only business we hear of is in small parcels, for which full figures were obtained. We quote: Ts, $27.50@$28; D. H., $30@$31.

PHILADELPHIA, Oct. 31, 1882.

Plate and Tank Iron.—There is nothing very encouraging in the immediate outlook, so that prices may be considered weak and irregular as follows: Tank iron, 3@3.25c.; Shell Iron, 3.8@4c.; Flange, 4.75@5c., and Fire-box, 5.75@6c.

Structural Iron.—The demand has been fair, and prospects of additional business within a few days seem to be good. Several contracts for bridge work are about being closed, and there is every reason to expect plenty of work in this department. Prices are very steady, and may be quoted same as last week, viz.; 3c. for Angles, 3.85@4c. for Tees, 4c. for Beams and 4.2c. for Channels.

Wrought-Iron Pipe.—Prices are rather weak, and orders for Gas and Steam Pipe have been taken at 57½ per cent. to 60 per cent. discount, and for Boiler Tubes at 47½ per cent. to 50 per cent. Large orders are said to have been taken for some sizes at still heavier discounts, and the entire line is weak and irregular.

Railway Fastenings.—Spikes are in fair demand at about 2.90@3c., but no very large lots could be placed at these figures. Fish Plates are quoted 2.5@2.6c., but there is not much business doing.

PITTSBURGH, Oct. 31, 1882.

Wrought Iron Pipe.—The mills are still well supplied with orders and are likely to have all they can do until the close of the year. The large production, however, is, as might be expected, having its effect in easing up prices, and will again increase discounts. We now quote at 62½@65 per cent. off on gas and steam pipe, and 47½@50 per cent. off on boiler tubes; oil well tubing, 20c. per foot, net; do. casing, 70c. per foot, net.

Railway Supplies.—There is a moderate business at former prices. Spikes, 3c., 30 days; splice bars, 2.50c.; track bolts, 3.75c. with square, and 3.90@4c., with hexagon nuts.

(From the American Manufacturer.)

ANGLE IRON.

[Carnegie Bros. & Co., Limited.]

(Net f. o. b. cars, Pittsburgh.)

	Cts.
Equal sided—⅝x⅝ to 1x1 to 1¼x1¼ in.	[illegible]
" " 2x2 to 4x4	[illegible]
Unequal sided—2x1½ to 4x3 in.	[illegible]
Square root angles—1x1 to 3x3 in.	[illegible]
Star iron—1½x1½ to 4x4	[illegible]
Sash iron—[illegible]	[illegible]
Various shapes	[illegible] to 4

TEE IRON.

1 inch and upward	[illegible]

BEAMS AND CHANNELS.

Solid wrought iron beams—		Cents.
3 in. to 10½ in. x30 ft.	per lb.,	4
12 in. by 30 ft.	"	4
15 in. by 30 ft.	"	4
Deck beams—7 in. to 9 in. by 30 ft.	"	[illegible]
Channel bars—1 in. to 12 in. by 30 ft.	"	4.2
" " 15 in. by 30 ft.	"	4.2

PLATE IRON.

	Cents.
Universal mill plates—plates not over 30 in. wide by ⅜ in. thick and upward	per lb., 3½

BRAZILIAN EXCHANGE.

Oct. 4, 1882.

Par value of the Brazilian mil reis (1$000), gold	27 d.
Par value of the Brazilian mil reis (1$000) gold in U. S. coin at $4.84 per £1 stg.	54.45 cents.
Par value $1.00 (U. S. coin) in Brazilian gold	1$837
Par value £1 stg. in Brazilian gold	8 889
Bank rate of exchange on London to-day	21½
Present value of the Brazilian mil reis (paper)	780 rs. gold.
Present value of the Brazilian mil reis in U. S. coin at $4 80 per £1 stg.	42.12½ cts.
Value of $1.00 ($4.80 per £1 stg.) in Brazilian currency (paper)	2 371
Value of £1 sterling, currency (paper)	11 395

RIVERS AND HARBORS.

WORK has been commenced on the harbor at Kenosha, Wis., by Messrs. Knapp & Gillen, the contractors.

SURVEYING THE MISSISSIPPI.—NEW ORLEANS, Oct. 30.—A special to the *Picayune* from Vicksburg says: "Assistant Engineer Wheeler is here in charge of the boats Illinois and Kentucky, of the River Commission, with a surveying party of 40 men. They will leave tomorrow for a point seven miles below the city. They will make a topographical survey of the river as far down as Natchez."

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR..............ASSOCIATE EDITOR.

SATURDAY, NOVEMBER 4, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6 50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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A SUCCESSFUL ARTESIAN WELL.—About one year ago several enterprising citizens of Mount Vernon, N. Y., formed a corporation for the purpose of obtaining an adequate supply of pure water. After thoroughly studying the various systems of obtaining water, they decided to sink an artesian well, reasoning from analogy that as wells in similar geological formations yielded bountifully, their chances of striking a water-bearing crevice at a reasonable depth, were good. Geologically considered, the structure of Westchester County closely resembles that of Manhattan Island, and with but two or three exceptions, wells sunk on the island have been successful. A contract was made for the sinking of a well eight inches in diameter, and from 300 to 700 feet deep, according to the supply. On the 23d ult. the well was finished at a depth of 502 feet. A wrought iron tube was driven through the surface to a depth of 30 feet when it struck solid rock. As the water rose above the surface, the well may be considered as a flowing one. The water was found to be soft, clear and cold. A pump was attached, and when running at the rate of 100,000 gallons a day, was unable to diminish the supply. It is calculated that this is sufficient for 8,000 or 4 000 people. The well is about 130 feet above tide water. With an expenditure of not more $75,000 for pumps, pipe, well, etc., a sufficient supply will be obtained for both domestic and fire purposes.

◆

EARLY AMERICAN BOOKS ON SURVEYING.

The surveying done during the eighteenth century in the American woods was, as every one knows, of a rude and elementary character. There was no American literature and little American science. When William Penn wished to run the boundary line between Maryland and Pennsylvania, he was obliged to send to England for two surveyors to do the work. The methods used in land measuring were almost entirely taken from English practice. The compass was the only instrument used for measuring angles and determining directions. Almost the only contribution of the century to surveying science was the method of computing areas from compass surveys by means of latitudes, departures and double meridian distances. This was the work of David Rittenhouse, the Pennsylvania mathematician and astronomer, who, like Benjamin Franklin, seems to have been almost alone in his solitary studies.

Of course, the books used in these early times came from England. Dix, Love and Gibson appear to have been the authors most read. In 1780 or thereabouts a reprint of Gibson was published at New York, wherein, says the title page, "everything that is useful and curious in the art of surveying is fully considered and explained." Gibson seems to have been a favorite work, for various editions and revisions were issued during a period of forty years. The edition of 1798 boasts of containing "alterations and amendments adapted to the use of American surveyors," which mainly consisted in the addition of the Rittenhouse, or Pennsylvania method for computing areas.

At Wilmington, Del., appeared in 1799 "a compendious treatise on practical surveying, concisely defined, methodically arranged and fully exemplified, by Zachariah Jess, schoolmaster." It contained 212 pages of text and 152 of tables, and in spite of its boastful title-page was really a very excellent book and one that shows its author to have been a careful and pain-staking man. The logarithmic tables have five decimals only, and in that respect are far better than those in the text books of the present time.

Very soon after, either in 1800 or 1801, Amos Eaton, a botanist and surveyor, printed at Hudson, N. Y., a little 18 mo. pamphlet called "Art Without Science," wherein "mensuration, surveying and engineering are divested of the speculative principles and technical language of mathematics." Copies of this are very rare. In 1880 it was reprinted at Albany in octavo form, revised and enlarged to 96 pages. Its contents are readable and interesting throughout. The author in 1828 became the principal and senior professor of the Rensselaer Institute at Troy.

Abel Flint, of Connecticut, published in 1804, at Hartford, a book with a long title-page treating of trigonometry and surveying, which included, says the preface, "all which is requisite in field surveying, both on the old and new plan." This was a very popular book, and it went through many reprints and editions, the last of which, we believe, appeared in 1852.

John Gummere, of Philadelphia, in 1814, published the first edition of his Surveying, which likewise proved a great success, and the later editions of which are even now, we think, used in some of the schools in Pennsylvania.

There may be, perhaps, other books on surveying published in the later years of the last century or the earlier ones of this century, but they have not come to our notice. Books in those times were books. The purchasers studied and read them with care. The authors spent much thought and labor in improving their successive editions, for stereotyping was then unknown and each new edition was actually a new reprint. After 1840 books on surveying became very common. Every author of a course of mathematical works wrote one, so that to-day their number is legion. Every one of them contains the rectangular method of Rittenhouse for computing areas and the same tedious talk about the variation of the magnetic needle. The picture of Jess showing how to find the height of a tree has become the common inheritance of scores of books, which, notwithstanding the wonderful material progress of the age, are but very little better than his methodical work.

◆

THE IRON TRADE.

Despite the extensive increase of facilities for making iron and steel, consumption of these products is steadily increasing both abroad and at home, and the quotations continue steady in nearly all the markets. This fact indicates a very healthful condition of the trade. Under ordinary circumstances this enormous increase in capacity would be naturally followed by a decline in prices, and by a hesitancy of buyers to push into the market. As it is, however, there is a steady increase in consumptive requirements, and buyers are providing for future requirements in a manner which indicates great confidence in the future steadiness of prices. The long suspension in the summer, of so many mills, has contributed a great deal to this result, and those buyers who have been expecting a break in prices in consequence of resumption have thus far been disappointed. The far West and the Southern States are heavy purchasers of all kinds of iron products. The increase of mining operations, of railroad building and of the general manufacturing industries have all combined to open up a very large market for these products, and especially for machines and machinery, besides tools, hardware and all the finer products. The general condition of trade throughout the West is satisfactory, but as heretofore stated, is not expanding as rapidly as had been expected. Iron manufacturers are hoping for too much and many of them are too sanguine.

Our development is extraordinary and there is no occasion for complaint. We are building nearly 1,000 miles of railroad per month. The locomotive establishments and all the old and new bridge works are crowded with orders for months to come. Railway companies are making liberal expenditures for bridge works and renewal of road, and construction of branch lines, and lateral connections. Motive power is in great request and rolling stock is wanted about as fast as our immense car-making capacity can meet it. There is no cause for complaint whatever, and while we are not on the verge of a boom, nor in any danger of such a calamity, yet there is every indication of very satisfactory industrial activity, and, what is more satisfactory, it presents numerous evidences of being prolonged. In some directions there may be cause for apprehension, as, for instance, in financial matters. It is no use to pay particular attention to the daily and weekly ups and downs of stocks and bonds; but it is advisable for the captains of our great industries to keep in mind the general course of events and the general direction of the influences and tendencies which control the volume of, and demand for money. The scarcity of money is a serious thing. The importance of a sufficient volume of money is, perhaps, not sufficiently considered by American business men. They know how to make, sell and use machinery and all the various products which form the basis of our industrial and commercial activity, but they too frequently ignore the vital importance of a sound financial system, one which will enable them to effect all exchanges without loss. The demand for currency is rapidly increasing while the supply is evidently not maintained in like proportions. The production of gold and silver adds but a small quota of what is necessary. The expansion of the paper currency does not keep pace with the expansion of domestic exchanges as indicated by bank and other returns. Should a stringency occur it will be taken advantage of by those who deal in money and its use. A stringency is likely to be followed by a greater stringency and produce evils which it is desirable should be avoided, in view of our past experience. The iron and steel manufacturers are perhaps more deeply interested in a good financial system than any other class.

The foreign markets for iron are very firm and the recent strikes in the coal and iron trades have brought about an advance of finished iron of from five to ten shillings per ton. Stock are decreasing and the number of furnaces in blast is increasing. At present it is 569 against 547 at the first of the year, with 350 out now against 376 at the beginning of the year. Nearly all markets are firm and buyers are looking forward for stocks which will very likely keep the market firm for a long time to come. The iron workers have secured *their* advance, and the miners theirs in part. Conferences have been held, and it is the intention of the workers to push the agitation for an advance in all parts of the kingdom. The result will be to restrict the exports of iron somewhat for a while, but as it is probable the American market will follow closely on the heels of the foreign, the opportunities to export iron to this side will still be offered and accepted. All furnaces and mills throughout the country are busily engaged on orders which will likely absorb their out-put to the end of the year. No effort will be made in a general way to provide for next year's requirements until December, when the strength of the market either upward or downward will have been demonstrated.

WHAT GOOD IS IT?

This is the question that a distinguished civil engineer asked us several months ago, in relation to Mr. Croes "History and Statistics of American Water-Works." He remarked that he could not see what the author meant by putting in so many figures that nobody would read. But a few days ago he had changed his tune. He had been called on to testify as an expert about some water-works. He was expected to swear that a certain scheme was feasible and advantageous for a certain place. He was puzzled to know how to prove his case exactly. While he was cogitating how he could evolve out of his inner consciousness facts to sustain his client's side, his weekly number of ENGINEERING NEWS was brought in. He looked over it, and lo! there were full and concise data of a precisely similar case to the one he was to support, proving by facts that such works were feasible and remunerative. He put the paper in his pocket, read it on the cars; swore his swear with ease and effect, and pocketed his fee.

That is where the benefit of these papers is and will be felt. There is not in existence such a collection of facts relating to water-works, divested of all theories and fancies, as is contained in the descriptions of the 400 water-works we have already published.

There are about 250 towns more from which we must have returns. The officers of the works have been again and again appealed to, but they do not respond. Why is this? They may be assured that it is our intention to republish these histories in book form as soon as practicable. We want to do this early in 1888, and the sooner we get in all the returns the sooner will this valuable work be at the service of the committeemen, engineers and contractors who are interested in the subjects treated of. Will not our readers take an interest in getting the desired returns forwarded to us?

WANTED.

We publish below a list of the towns which have been reported to us as having water-works, but which have not yet sent any returns to Mr. Croes. It is possible that there are no works in some of them. We will be glad to hear from some of our readers with reference to every town on the list. If they have no water-works, let us know. If they have, or if there are any others which have, and are not on this list, nor among the 400 already described, we hope that some one will stir up the officials to send a return to Mr. Croes on the blanks he has already sent them, or if, as in one case we know of, the blank was put in the waste basket, that they will send for another, fill it out and return it.

The *Sanitary Engineer*, which is noted for the soundness of its judgment on matters affecting the interests it advocates, feels, as do other professional journals, the want of just such a book as we are now publishing in our columns and hope soon to issue separately. In discussing the question of water rates and the share of the cost of the water-works which ought to be borne by the public at large, it says:

"Whether it is fair to impose on property so large a proportion of the cost of the works, as is done in many towns, is a question worth discussing. The data for a fair discussion have not heretofore been obtainable, but we hope that the volume of Statistics of American Water-Works, by Mr. Croes, which is promised at an early day, will place in a form convenient for analysis all the facts necessary for a full comprehension of this subject."

We hope that every one of our readers will aid us in procuring the data necessary to complete this invaluable work.

Aberdeen, Miss.
Abilene, Kan.
Alliance, O.
Anaheimo, Cal.
Archbald, Pa
Arlington, Mass.
Atchison, Kan.
Atlantic City, N. J.
Attica, Ind.
Atlantic, Ia.
Augusta, Me.
Austin, Tex.
Ballston Spa, N. Y
Bayside, N. J
Belfast, Me.
Bellefonte, Pa.
Bellevue, O.
Berthier, Can.
Bethlehem, N. H
Biddeford, Me
Birmingham, Pa
Bodie, Col.
Boyertown, Pa.
Brampton, Ont
Brattleboro, Vt.
Brandon, Vt.
Brazil, Ind.
Bridgeport, Conn.
Bristol, R. I.
Brocton, Mass.
Brookville, Ind.
Bryn Mawr, Pa
Burlington, Vt
Butler, Pa
Butte, Mon
Cadillac, Mich.
Calais, Pa.
Canton, O
Candelaria, Nev.
Cape May, N. J.
Caribou, Col
Carlisle, Pa.
Central City, Col.
Chattanooga, Tenn.
Cheboygan, Mich.
Charlestown, Ill.
Chambersburg, Pa.
Cheshire, Mass.
Chillicothe, O
Clarion, Pa.
Claremont, N. H
Colorado Springs, Col.
Cohoes, N. Y.
College Point, N. Y.
Columbia, Pa
Columbia, S. C
Columbia, Cal.
Columbus, Ga.
Constantine, Mich
Cooperstown, N. Y
Coatesville, Pa.
Connemaugh, Pa.
Corsicana, Tex.
Crestline, O.
Crookston, Minn.
Cumberland, Md.
Danville, Ill.
Danville, Va
Davenport, Ia.
Deadwood, Dak
Dover, N. H.
Doylestown, Pa
Dunmore, Pa
Easton, Pa.
Easthampton, Mass
Edgewater, N. Y.
Elmore, Mich
Ellenville, N. Y
Emmaus, Pa.
Ephrata, Pa.
Fair Haven, N. Y
Farmington, N. H
Fayetteville, N. C
Flemington, N. J
Flushing, N. Y
Fond du Lac, Wis
Fort Dodge, Ia
Fort Edward, N. Y
Franklin, Pa.
Fredericksburg, Va.
Fredonia, N. Y
Freeport, Ill.
Frostburg, Md
Galion, O
Garden City, N. Y
Gettysburg, Pa.
Geneseo, Ill
Geneseo, N. Y
Gilroy, Cal
Glens Falls, N. Y
Golden, Col.
Grand Island, Neb.
Grass Valley, Cal
Grand Haven, Mich
Great Falls, N. H
Gridley, Cal
Hackensack, N. J.
Hagerstown, Md.
Hamorton, Pa.
Hazleton, Pa
Haverhill, Mass.
Holly, Mich
Honesdale, Pa
Houston, Tex
Huntsville, Ala
Hyde Park, Ill
Hyde Park, Vt
Independence, Mo.
Ithaca, N. Y
Ishpeming, Mich
Jacksonville, Ala.
Jamestown, N. Y
Jamestown, Pa.
Johnstown, Pa.
Kennett Square, Pa.
Kingston, Ont., Can
Kingston, Mass.
Kittanning, Pa
LaCrosse, Wis
LaPorte, Ind.
Lansford, Pa
Lakeview, Ill.
Las Vegas, N. M
Leavenworth, Kan.
Lewiston, Me.
Lewistown, Pa
Lexington, Va.
Lincoln, Neb.
Lindsay, Ont.
Little Rock, Ark.
Locust Mountain, Pa
Long Island City, N. Y.
Longmont, Col.
Los Angeles, Cal.
Madison, Wis.
Marion, Ind.
Marlboro', Mass.
Marquette, Mich.
Marysville, Cal.
Maysville, Ky.
Mechanicsburgh, Pa
Media, Pa.
Medina, N. Y.
Middletown, O.
Milford, Pa.
Milford, Mass.
Minersville, Pa.
Mitchell, Can
McKeesport, Pa
Modesto, Cal.
Mobile, Ala.
Moncton, N. B
Monongahela, Pa.
Montpelier, Vt.
Morgantown, Pa.
Morris, Ill.
Mount Morris, N. Y.
Mount Vernon, N. Y
Muskegan, Mich.
Massillon, O.
Nevada City, Cal
New Castle, Del
Norwalk, Conn.
Olympia, W. T.
Oneonta, N. Y.
Orange, Mass.
Oregon, Ill.
Oskaloosa, Ia.
Oxford, Pa.
Parker City, Pa.
Parkersburg, W. Va
Peabody, Mass.
Perth Amboy, N. J.
Peru, Ind.
Placerville, Cal
Plattsburg, N. Y.
Plymouth, Pa.
Portland, Mich.
Portland, Or.
Port Jervis, N. Y.
Port Richmond, N. Y.
Portsmouth, N. H.
Pottsville, Pa.
Prescott, Ariz.
Providence, Pa.
Putney, Vt.
Raleigh, N. C.
Reading, Pa.
Red Bluff, Cal.
Renovo, Pa.
Reynoldsville, Pa
Rock Island, Ill.
Rockville, Conn
Rutland, Vt.
Saginaw, Mich.
Salem, O.
Salem, N. J.
San Jose, Cal
St. Joseph, Mo
San Antonio, Tex.
St. Cunegonde, Can.
St. Gabriel, Can.
St. Peter, Minn.
St. Thomas, Can.
San Rafael, Cal
Santa Cruz, Cal
Santa Fe, N. M.
Silver Cliff, Col.
Seaforth, Can.
Seattle, W. T.
Shamokin, Pa.
Shelburn Falls, Mass
Shelton, Conn.
Sherman, Tex.
Shenandoah, Pa.
Sorel, Can.
South Adams, Mass
Springfield, Ill.
Stamford, Conn.
Sterling, Ill
Steubenville, O.
Stockton, Cal.
Stonington, Conn.
Summit Hill, Pa.
Sycamore, Ill.
Suspension Bridge, N. Y.
Tamaqua, Pa.
Tecumseh, Mich.
Tiffin, O.
Topeka, Kan.
Towanda, Pa.
Tower City, Dak.
Tyrone, Pa.
Union City, Ind
Vergennes, Vt.
Wakefield, Mass.
Washington, Ind
Walton, N. Y.
Washingtonville, N. J
Watsonville, Cal.
Walkerton, Can.
Walla Walla, W. T
Warren, Mass.
Warren, O.
Warren, Pa.
Waterville, Me.
Wayland, Mass.
Wellsville, O.
West Brookfield, Mass
Westminster, Vt
Whitehall, N. Y.
Wheeling, W. Va
Windsor, Can.
Windsor, Vt.
Winnipeg, Man.
Winchester, Va
Wolcottville, Conn
Woodford, Cal
Yarmouth, Can
Yorkville, Can.
Youngstown, O

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

THE $40,000 worth of bonds recently issued by Asheville, N. C., for macadamizing the principal streets and establishing water-works, have been sold at par. The committee has commenced upon both of these improvements.

MAQUOKETA, IA., is going to have water-works.

PULLMAN, ILL.—The amount of water used each day is 500,000 gallons. This is the source of a handsome revenue to the village of Hyde Park, as by contract with the Pullman Company, the latter corporation is to pay to the village $59 per million gallons, which, at the present rate, will amount to over $850 per month, or over $10,000 per annum.

THE gates through which Jersey City supplied Hoboken with water have been closed. Hoboken has made a new contract with the Hackensack Water Company for a water supply. Jersey City loses $80,000 per year by the change.

THE Murphysboro (Ill.) Coal-Gas Company has been incorporated; capital, $40,000.

LAKE VIEW, ILL., has passed ordinances for the buying of 4 and 6-inch water pipes.

THE WATER-WORKS extension at Toronto, Canada, has been completed. A pipe 6 ft. in diameter runs out into the lake about 2,600 ft. to deep water. It was laid in lengths of 100 ft. The water obtained is pure and clear.

IOWA CITY, IA., will soon have the Holley system of water-works in operation.

ELECTRICITY.

THE Phœnix Electric Company of Chicago, Ill., has been incorporated. Capital, $250,000.

PROGRESS OF ELECTRICITY.—The Chesterfield Town Council have resolved to apply to the Board of Trade for power to supply the town with the electric light.—An installation has just been completed with Swan lamps and Faore accumulators in the Paris Opera-house. The representatives of the Opera-house have expressed themselves extremely pleased with the result. All the main cables are covered with lead, and every lamp is protected with lead cut-outs to avoid any possible chance of fire.—The extensive premises known as Waterloo House, Trafalgar Square, have just acquired a very successful installation of 16 arc electric lights, which have been furnished by the Metropolitan (Brush) Electric Light Company, the power-generator being a 12-horse power (nominal) Otto gas-engine.—Pentonville Hill, Clerkenwell, is now illuminated with 82 incandescent lamps, supplied by the Maxim-Weston Electric Lighting Company.—Siemens & Co. have recently received instructions to extend the electric lighting installation at the Royal Albert Dock, so as to include the south side of the dock.—*The London Ironmonger.*

RAILROADS.

A SCHOOL CAR.—The Central Hudson Company is building at West Albany, N. Y., a "school-car," to be used in teaching engineers how to handle the Westinghouse air-brake. Every passenger engineer will be required to have a certificate of instruction.

ROAD INCORPORATED.—Articles were filed at Albany on the 1st by the Lackawanna & Pittsburgh Railroad Company, capital $4,000,000. The road is to begin at a point on the Genesee Valley Canal Railroad, at or near Rockville, running thence in a northeasterly direction by the most feasible route to a point on the New York, Lackawanna & Western road, at or near the village of Perkinsville, with a branch beginning at a point on the line of the Lackawanna & Pittsburgh Railroad at or near the intersection of the railroad with the boundary line between the counties of Alleghany and Steuben, running thence in a southeasterly direction by the most direct route, by way of the village of Hornellsville, to a point near the village of Canisteo. The length of the branch is to be 16 miles, and that of the main road 42 miles.

THE VIENNA ELEVATED RAILWAY.—The *Neue Freie Presse* states that the Austrian Government has determined to grant the concession for the Vienna Elevated Railway to the English Company Fogerty. The municipality and magistracy of Vienna will only now have to discuss the question of technical construction. The line will be concessioned as an elevated railway, and the entire iron required for the construction—from 150,000 to 180,000 tons—will be furnished by works in Austria. A contract for the greater portion of this quantity has already been concluded with the Wittkowitz Iron Works.

THE Lebanon Valley (Pa.) Railroad is being laid with steel rails.

THE TOLEDO, CINCINNATI & ST. LOUIS RAILROAD has purchased 113 acres of land in St. Louis, and will build depots and warehouses.

EXTENSIVE WORKS for the manufacture of rails, rods, bars, etc., are to be built at Murphysboro, Ill. There will be 35 buildings, covering 65¼ acres; the whole to be completed within four years, and to cost $5,000,000. The works will include six blast furnaces, double steel works, rail mill, plate mill, universal mill, blooming and billet mill, iron and brass foundry, and hoop, cotton tie and bar mills. Some 2,500 workmen will be employed.

BUILDING OPERATIONS IN MEXICO.—CITY OF MEXICO, Oct 31.—The City Architect reports 2,000 houses inside the corporation limits as being built or undergoing repairs. Several parties are speaking of constructing a large American hotel.

THE Hurricane Granite Company recently advertised for 100 granite cutters at Hurricane, on an eight months' job.'

A SURE cure for chapped hands is something greatly to be desired by stone-cutters. Try this: Wet your hands in warm water, then rub them all over with Indian meal; do this twice, then in the water used to wash off the meal put a teaspoonful of pure glycerine. If it is not pure, it will irritate the skin.

THE laying of the track for the Wisconsin Central Railroad, between Neehah and Oshkosh, has just been completed.

NEW GEORGIA RAILROAD.—The Augusta, Elberton & Chicago Railroad Company has been organized at Augusta by electing James P. Verdery, president; H. J. Lang, vice president, and H. P. Moore, treasurer.

ARTICLES of incorporation have been filed in Little Rock, Ark., for the Dardanelle & Waldron Railway Company, with $750,000 capital, and the road will be 75 miles long.

BRIDGES.

NEW BRIDGE.—The Chicago & Alton road is building a new iron bridge over the Kankakee River, between Joliet and Coal City. It is to be 1,000 ft. in length, and will be completed in about a month.

GRANITE FOR THE BROOKLYN BRIDGE.—From an exchange we take the following:

The list of the firms which have supplied granite for the East River Bridge, New York, down to the close of the granite account, with the amount paid to each firm, is as follows:

Bodwell, Webster & Co.	$36,163.63
Bodwell Granite Co.	19,031.94
Bodwell Granite Co. (2d contract)	355,394.85
Cape Ann Granite Co.	74,840.83
Collins Granite Co.	325,452.17
Pierce, Rowe & Co.	151,529.01
Pierce & Rowe	6,951.30
John T. Rowe	5,871.92
Beattie & Dresser	20,087.98
John Beattie	11,032.05
Rhode Island Granite Co.	14,800.52
Joseph Wescott & Sons	10,841.01
Joseph Brennan	8,372.04
C. J. Hall	4,517.70
C. P. Dixon	611.92
Concord Granite Co.	45,318.35
Eagle Quarry Co. Assignees	7,290.00
C. C. Borrell	2,300.00
Since Jan. 1 to May 1, 1881, the following money has been paid for granite to various firms in small sums (including the Bodwell Granite Co.)	22,100.00
Total	$2,118,106.90

BRIDGE FINISHED.—SAVANNAH, Ga., Oct. 30.—The iron bridge over the Savannah River was completed at 5 o'clock this afternoon. It cost $100,000.

BRIDGE TO BE WIDENED.—The Commissioners of Norfolk County, Mass., have granted the petition of the Boston and Providence Railroad Company for permission to widen the bridge over River street in Hyde Park, and specify that the bridge shall extend across the whole railroad location, and shall be 50 ft. wide, 18 ft. in height above the tracks, and to be of wrought iron, with two trusses of 78 23-100 ft. span placed 31 5-10 ft. between centres, and each truss placed so that its centres shall be 9 25-100 ft. from the line of the street.

THE LARGEST ARCH.—The dimensions of the union arch of the Washington aqueduct, it would appear, exceed those of any of the celebrated engineering structures which are most commonly pointed to as wonderful achievements in masonry. The entire span is 220 ft., or 20 in excess of the span of the famous Chester arch across the Dee in England; 68 ft. longer than the central arch of London bridge; 92 ft. longer than the noted bridge over the Seine at Neuilly, and 100 ft. longer than the arches of the Waterloo bridge over the Thames. The height of the Washington arch is 101 ft.

BUILDING.

WORK has begun upon the foundation of the new machine shops in Bath, Me. The buildings are to be 60 ft. wide and the dock filled in even with the river front of the wharf.

PROPOSALS FOR HEATING APPARATUS.—Jas. G. Hill, supervising architect of the Treasury, will receive proposals until Nov. 22, 1882, for furnishing and placing the low pressure steam-heating apparatus required for the post-office and sub-treasury extension, Boston, Mass.

A BIG DEPOT AT MONTREAL.—The Canadian Pacific directors and a committee of the Montreal Corporation came to an arrangement recently for the erection by the former of a monster depot, costing $2,000,000, in the east end of Montreal. The Council will contribute $200,000 cash, in addition to 225,000 square feet of valuable city property as subsidy.

LITERATURE.

The publisher of the Kansas City *Review of Science and Industry*, a 64-page monthly devoted to Progress in Science, Mechanic Arts and Literature, offers the remaining half of vol. VI. for $1, the subscription for the volume being $2.50.

CONTRACTS LET.

IT is reported that the Bodwell Granite Company, at Vinalhaven, Me., have secured the contract for a large building to be erected in Chicago. It is a two years' job for the present force of cutters.

THE contract for about 30,000 tons of rubble stone for the breakwater in the Rockland (Me.) harbor, has been awarded to John F. Hamilton, of Portland, the lowest bidder. It is understood that work will be resumed on the job this fall, and continued so long as the weather remains moderate enough to permit.

RAILROAD CONTRACT LET.—Major A. J. Twiggs, of Augusta, Ga., has made a contract with the directors of the Georgetown & Lane's Railroad Company for the building and equipment of a railroad from Georgetown to Lane's depot, on the Northeastern Railroad in this State. The length of the line is 38 miles, and the construction of the road will give Georgetown her only railway connection and open up a fine country. The work is to be completed by Nov. 1, 1883. The contractor is to receive a private cash subscription of $25,000 made by the municipality of Georgetown, and first mortgage bonds of the railroad company sufficient to cover any additional cost of construction that may be incurred.

GRANITE CONTRACT LET.—The following are the bids for furnishing cut granite for the approaches of the north wing of State, War and Navy departments building:

Elsworth & Rice Hill Granite Co.	$57,567.00
M. K. Chase	53,065.00
Collins Granite Co.	58,198.92
Davis Tillson	59,048.17
Old Dominion Granite Co	63,563.00
Gill & McMahon	67,223.00
Concord Granite Co.	69,157.00
Cape Ann Granite Co.	69,281.35
Bodwell Granite Co	73,310.00
Mt. Waldo Granite Works	89,804.00

The contract has been awarded to Davis Tillson, the lowest bidder submitting a sample of granite fulfilling the requirements of the specifications.

CONTRACT FOR GRANITE FOR BRIDGE PIERS.—The bids for the piers for the new iron bridge at Lowell, Mass., were three, as follows: W. H. Ward, $59,522; O'Hearn Bros., $61,529; Runels & Trumbell, $61,663. The contract was awarded to Mr. Ward. He is to remove the present piers, put a new one where the present northerly one stands, and another a few feet north of the southerly one. The new ones will be set on 114 piles each, these being sawed off four or five feet below low water mark, and enclosed with a curb of sheet piling and concrete. The piers will be twenty-six feet above low water mark, built of cut stone. Much of the material of the old piers will be used in the new ones. The abutment between the Massachusetts and Boott mills will have to be carried out twenty-five feet into the stream, to coincide with the wall of the extended Boott mill. The work is to be done by Feb. 1, 1883, ready for the iron superstructure.

MISCELLANEOUS.

LUMINOUS PAINT.—A party of gentlemen recently made a trip on the Southeastern Railway, in England, with the object of testing the luminosity of a railway car, a portion of the interior of which had been coated with Balmain's patent paint. The weather being dull, the zinc plates, which had received three coats of the paint specially hardened, were less sensitive than would have been the case had sunshine struck directly upon them; but, notwithstanding, on entering Blackheath tunnel, an agreeable, equally-diffused light proceeded from the ceiling of the compartment and the two ends, the advertisements on which were seen clearly. The hands of a watch were also easily discerned, and the headings of newspaper articles read. Containing no phosphorus, the paint was without smell.

TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

One year afterward another patent for a bridge was issued. It was granted Feb. 3, 1834, to one Jonas Snyder. This bridge consisted of double wooden chords between which the posts or uprights were placed running up to the top of the bridge and about eight feet apart. These posts were set so as to lean outward toward the two ends of the bridge at different angles of inclination, as shown in the illustration. The first or lower arch was arranged to spring from the pier about four or five feet below the chords. The second, or arch just above, was constructed precisely like the lower one, but sprang from the end of the bridge immediately above the chords. The arch pieces curve, as seen in the bottom view of the bridge. A small inter-tie may be put in with tenons from post to post along the length of the bridge.

January 23, 1836, Stephen H. Long, United States Topographical Engineer, devised a bridge, the object of which was "to produce and insure lateral stiffness or inflexibility in wooden or frame bridges." This object was effected, as shown by the drawings, by means of a system of "lattice" bracing, applied either to the upper or lower strings or chords of the bridge, or to both, as was deemed advisable. The lattice bracing was to consist of timbers about 3 by 9 to 12 inches transversely, and of any appropriate length, applied diagonally either above or below the strings, an application to the upper strings being deemed preferable. They are attached to the chords by bolts, spikes or treenails, passing through the brace timbers at their intersections and through the strings or chords at the places where the two are attached. The arrangement of the brace timbers is such as to exhibit two sets of braces, one antagonal to the other, the timbers in each set being parallel to each other, or nearly so. The arrangement also provides that one set of the braces shall rest or recline upon the other in such a manner that the ends of the braces of one set shall rest immediately upon the ends of the other set. The brace timbers of each set are confined to those of the other set, at every intersection, by similar fastenings.

In the use of lattice bracing to the upper strings of a bridge, the necessity of beams to confine the strings together, and to afford the requisite supports for roofing, is entirely obviated. A beam, however, is required over each pier and abutment to serve as a band for the lateral bracing, and more especially to afford the means of introducing transverse braces to better advantage.

Fig. 1 of the drawings is a side view, Fig. 2 a plan, and Fig. 3 an end view. *A* is the upper set of lateral braces; *a* the ends of the same. *B* is the lower set, and *b* the ends thereof. *C* are the binders; *D* the beams over the abutments and piers, with their stay braces *C* the bolsters for sustaining the bridge, and *F* are iron stay braces for bracing the bridge transversely.

Francis Good, of Pennsylvania, next appears as an applicant for protection in truss bridges. His papers bear date Nov. 4, 1837, after the reorganization of the Patent Office from the fire of 1836. Taking the drawings into consideration his devices may be described as follows: Having turned the water off from the place where it is intended to construct the bridge, the bottom is prepared to receive two horizontal sills *A A*, one placed on each side of the stream. Upon these sills are the walls *B B* raised to a suitable height, which are to sustain the superstructure, and for preserving the banks, built of stone, about 2 feet thick, and sloped at the banks against stream. Parallel plates *C C* are placed upon the walls, and the transverse beams *D D* over these; near the ends are arranged plates of iron *E E*, and bolted thereto. *F* is the flooring. The bolts *G* pass through the whole structure, and secured by a key *H* passing through a mortise in its upper end. Over the sloped part of the walls is laid an iron plate *I*. At its lower end it is secured by a short bolt *J* passing through the sill and through the iron plate, secured by a key *K* on the top of the sill. The ends of the flooring planks are covered by a sheathing board *L*, and the transverse beams likewise by boards *M* to protect them.

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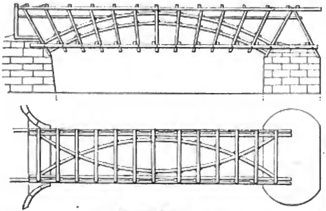
* Copyright, 1882.

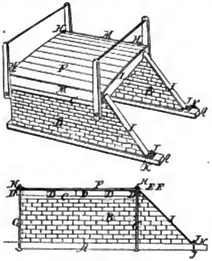

SNYDERS BRIDGE.

June 24, 1839, Henry Wilton, another Pennsylvanian, received a patent for a railway truss bridge. The nature of this invention was the combining of a right line or horizontal with an arch bridge in a novel manner.

In the plates, Fig. 1 is a side view of the bridge; Fig. 2, plan of the lateral bracing; Fig. 3, section through the line *A B* of Fig. 1; Fig. 4, section through the line *C D* of same figure, and projection of the arch.

A represents the latticed trusses, and *B* its chords. *C* are the lower transverse beams, and *D*, the upper transverse beams. *E* is the lateral bracing between the beams. *F* are the arches, and *G* the suspension bars. *H* are the stirrups at the lower ends of the suspension bars, and *I* represent the horizontal brace bolts; *K*, the abutments, *L* represents the railway on the top of the bridge, and *M* a section of a railway on the lower beams.

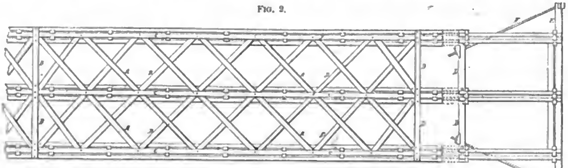
The trusses of this railroad bridge are composed of sma pieces of timber crossed at an angle of about 47°, pinned together and having parallel string pieces or chords. The arches are arranged on both sides of the trusses. The bridge is extended in length beyond the abutments for the purpose of producing a counter-balancing weight. The number o lattice pieces in this bridge is about one-fifth less than i usually put in a right line bridge, this reduced quantity of timber being in part supplied by the introduction of the segment arches combined with the horizontal trusses, and bearing endwise against the abutment.



GOOD'S BRIDGE.

This bridge, it is claimed, is stronger and bears a greater weight at a point where the right-line bridge, on the lattice principle, is weakest, namely, in the center of the span, whereas by this construction, the bridge, at this point is strongest, because the arch which supports it from sinking in the center, is strongest and will bear a greater weight at the vertex than at any other point. This mode of construction also relieves the abutments from a great portion of the lateral pressure consequent from the thrust of the arch.

FIG. 2.



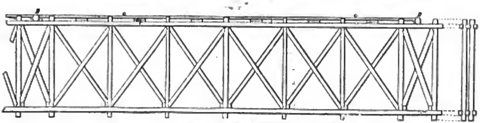


FIG. 1. LONG'S BRIDGE. JAN. 23, 1836.

In this year, 1839, Stephen H. Long, of the United States Army, was granted two patents for truss bridges, bearing date Nov. 7. The first patent, fourteen years after was extended by the Patent Office seven years, and the second was re-issued July 20, 1841.

The first of these illustrated by the plates, is composed of truss frames, arch and lateral braces, flooring, etc., and was distinguished from other bridges then in use, in that the posts acted by *thrust* instead of tension, and the main and counter braces by *tension* instead of thrust.

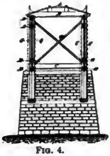


Fig. 4.

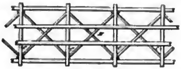


Fig. 2.

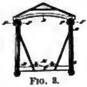
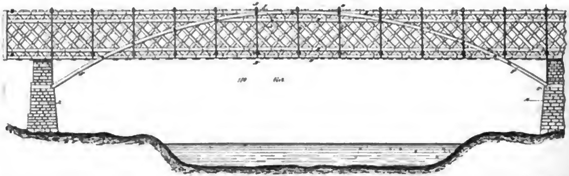
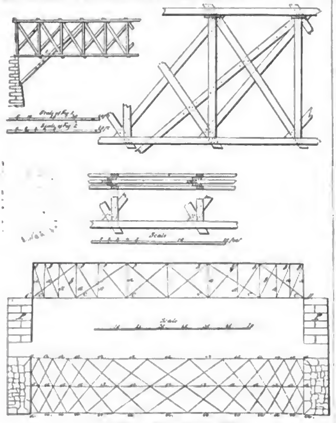


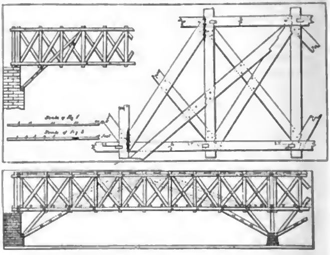
Fig. 3.


Wilton's Bridge.

The length of the posts of this bridge is such as to occupy the distance in the clear between the upper and lower strings or chords, or rather somewhat short of this distance, in order to admit a wedge, or a set of counter wedges, between one end of the post and the contiguous chord. The main braces occupy space between the central and outer chord pieces. At the center of the span the main braces are halved or locked together and tree-nailed to the chords as, also, are the other portions of the bridge. The counter braces are tree-nailed at the heads and feet between the main braces. Arch braces may be applied in a manner to act as suspension braces by erecting a gallows at each pier and abutment of sufficient height and strength.


(1) Long's Bridge. Nov. 7, 1839.

Engineer Long formulated a rule, at this early date, for giving an equable action to the main braces in all the panels of a bridge, viz: Let the extent of the bridge span between the abutments or piers be 120 ft., and the height of truss-frame, or rather the distance from center to center of the chords, be 15 ft. Now the first panels should have a distance measured on the chords from center to center of the post equal to 5¼ ft.; the second panel a distance of 6¼ ft ; the third equal to 7¾ ft.; the fourth 9¾ ft.; the fifth 13 ft.; and the sixth 18 ft.; making the aggregate extent of the half span equal to 60 ft. By this arrangement (and which is illustrated in diagrams 1 and 2), the main braces, it is asserted, will be subjected to nearly an equable action and their greatest possible efficiency may be rendered available.


(2) Long's Bridge. Nov. 7, 1839.

The second bridge construction of Engineer Long provides, instead of the notches, recesses and wedges in the chords of the before-mentioned patent, connections between the posts and chords consisting of gibs and keys passing entirely through the chords transversely, and resting in notches prepared for the reception of the gib and key in the back of the post or in the side opposite to the steps at which the main braces communicate their thrust against the posts. The arch braces rise in three or more pieces from a bench or bolster attached to the abutment, and pass through the lower string in two or more pieces. The splicing of the chords are effected by means of wooden splicing pieces in appropriate notches. The bracing is effected by locked lattice work.

(TO BE CONTINUED.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page 381.*)

CCCCII.—OWEGO.

Owego, New York, in lat. 42° 15 N., long. 76° 20' W., is on the Susquehanna River in a hilly region.

Water-works were built in 1879 by S. L. Wiley for a private company, taking the supply by gravity from Barnes Creek, a mountain stream of about 3 square miles water-shed. An earth dam 60 ft. high, with slopes of 2½ to 1 on the inside and 2 to 1 on the outside, forms a reservoir on the stream, 2½ miles distant from and 285 ft. above the town. The water is filtered through sand and gravel and conveyed through 12-in. cast-iron pipe to a small reservoir in excavation, with paved slopes, on a hill near the town. When the supply from this source is deficient in extreme drought, it is supplemented by pumping from a well in the upper part of the town by a compound Deane steam pump of 500,000 gallons daily capacity.

Distribution is by 10½ miles of pipe, of from 12 to 2 in. diameter. Pipes of 4 in. and greater diameter are of cast iron. Those under 4 in. are of wrought iron, coated with asphalte. There are 51 fire hydrants, 25 gates and 248 taps. The town pays $50 per year for each hydrant. Service-pipes are of wrought iron, coated with asphalte, and of lead.

The population in 1880 was 6,087 and the daily consumption is 200,000 gallons.

The capital stock of the company is $100,000. No further financial statistics are given.

S. L. Wiley is the general manager and H. W. Moore the Superintendent.

CCCCIII.—KINGSTON, CAN.

Kingston, Ontario, in Canada, in lat. 44° 8' N., long. 76° 41' W., on Lake Ontario, is on ground sloping up from the lake to an elevation of 80 ft.

It was founded in 1784 on the site of the old French fort Frontenac, which was built about 1675.

Water-works were built by a private company in 1849, after plans of R. L. Innes, taking the supply from Lake Ontario. A wooden crib, divided into compartments filled with coarse stone, gravel and sand, is submerged in the lake. From the bottom of this filter, which is said to be able to pass 3,000,000 gallons per day, the cast-iron suction pipe of the pumps is led. The water is lifted 80 ft. by a steam engine (beam) with double-acting vertical plunger pumps of 8-in. bore and 54-in. stroke, into a reservoir holding 600,000 gallons. An 8-in. stand-pipe, used to give fire pressure in the mains, rises 15 ft. above the reservoir. Distribution is by 10 miles of cast-iron pipes of from 8 to 3-in. diameter, with 42 fire hydrants, 45 gates and 816 taps. There are 20 meters. The city pays $275 per year for fire hydrant service. Service pipes are of lead.

The population in 1880 was 15,000. The daily consumption is 750,000 gallons.

The capital stock of the company is $120,000. The works have cost $160,000. There is no debt. The expenses in 1881 were $8,325 and the receipts $19,000.

R. L. Innes was Superintendent to 1854 and James Wilson has held the position since that year.

CCCCIV.—RENOVO.

Renovo, Pennsylvania, in lat. 41°15' N., long. 77° 45' W., is on the West Branch of the Susquehanna River, in a mountainous region.

Settled in 1863, it was incorporated as a city in 1867.

Water-works were built in 1872 by the city after plans of E. H. Walsh, taking the supply from a mountain stream, a dam across which forms a reservoir holding 20,000 gallons, 150 ft. above the city and three-quarters of a mile from it. A cast iron main conveys the water to the tank. Distribution is by 15 miles of wrought iron and cement pipe of from 10 in. to 13 in. in diameter, with 29 fire hydrants, 29 gates and 265 taps. Service pipes are of lead and of wrought iron.

The population in 1880 was 3,014. The daily consumption is not known.

The works have cost $65,000. The bonded debt is $45,000. The expenses are not given. The receipts in 1881 were $2,200.

The works are managed by the City Council. James H. Ferguson is the Superintendent.

CCCCV.—FREDERICKSBURG.

Fredericksburg, Virginia, in lat. 38° 20' N., long. 77° 25' W., on the Rappahannock River, is on a plain slightly elevated above the river and surrounded by hills.

Settled in 1727, it was incorporated as a village in 1727, as a borough in 1781, and as a city in 1870. Water-works were built by a private company in 1882, after plans of Alexander Henderson, taking the supply from Poplar Springs, half a mile from the town. It is distributed through 4 miles of cast-iron pipe, with 225 taps. There are no fire hydrants. Service pipes are of lead.

The population in 1880 was 5,000. The daily consumption is not known. The water is only used for culinary purposes. The citizens generally use water from wells provided by the city government. The capital stock of the company is $17,000. The works have cost $25,000. No further financial statistics are given.

J. W. Sever has been the Superintendent for 25 years.

CCCCVI.—LEWISTON, ME.

Lewiston, Maine, in lat. 44° N., long. 70° W., on the Androscoggin River, is on undulating ground, rising from the river to hills 350 ft. high. There is a fall of 70 ft. in the river opposite the city, which is utilized for water-power for manufacturing purposes. The source of the Androscoggin is a chain of mountain lakes with 80 square miles water shed, about 100 miles above Lewiston. The town was incorporated in 1795 and chartered as a city in 1863.

Water-works were built by the city in 1878 after plans and under superintendence of M. M. Tidd, C. E., taking the supply from the river above the falls and pumping it by two Worthington duplex pumps, of 3,000,000 gallons daily capacity each, driven by two Risdon turbines. A brick conduit conveys the water from the pond to the pump-well. In 1880 a filter of 400 square ft. area, with 32 in. of sand and sea gravel, was constructed in the conduit. The water passes up through the gravel and falls over a weir to the well.

The pumps lift the water 250 ft. through 10,450 ft. of 24-in. pipe to a reservoir 15 ft. deep, built in side hill excavation and embankment, the inner slopes paved with cobble-stones, and holding 15,000,000 gallons, at 220 ft. above the general level of the city. The pressure in the mains is from 70 to 120 pounds, according to location.

Distribution is by 28 miles of cast-iron pipe of from 24 to 4-in. diameter, with 148 fire hydrants, 175 gates and 1,800 taps. There are 25 meters in use. The city contributes $40 per year for each fire hydrant. Tarred wrought-iron service pipes are generally used, and some of galvanized iron.

The population in 1880 was 19,083. The daily consumption in 1881 was 1,016,260 gallons, with 1,518 taps.

The works have cost $500,000, including $200,000 paid for water-power and privileges. The receipts have been $61,332.38. The bonded debt is $474,000 at 5 per cent.

The expenses in 1881 for maintenance and repairs were $14,711.82, and the receipts $25,837.88.

The works are managed by a board of seven commissioners, one being elected by the City Council each year. James Dempsey is President of the board; John Read, Clerk and Registrar, and John F. Nash, Superintendent.

F. F. Forbes, Superintendent of the Brookline (Massachusetts) Water-works, and Edward S. Philbrick, C. E., having noted some inaccuracies in the description of those works on p. 251, ENGINEERING NEWS, of July 22, 1882, have furnished more complete data and a full set of the reports, which enable the following description to be prepared. It is to be substituted for the one previously printed:

CCCLX.—BROOKLINE.

Brookline, Massachusetts, in lat. 42° 40 N., long. 71° 10 W., on the Charles River and a small, tidal estuary called Muddy River, is bounded on three sides by the city of Boston. It comprises about 200 acres of salt marsh, 500 acres of a plain of river gravel rising to about 100 ft. above tide, and hills of glacial drift rising from 300 to 500 ft. above tide. Settled in 1634, it was incorporated in 1705.

Water-works were built by the town in 1875, after the plans and under the superintendence of Edward S. Philbrick, C. E., taking the supply from the ground water on Cow Island, a ridge of gravel surrounded by marshes, alongside of the Charles River, about 6 miles from the heart of the town.

A collecting gallery was excavated from 100 to 300 ft. from the river, in clean, coarse sand and gravel. Its bottom is 6 ft. below the lowest stage of the river. It is 4 ft. wide, with vertical side walls 2 ft. high, of uncemented rubble stone, and covered by a semi-circular brick arch 8 in. thick. At first, two sections, respectively 491 and 271 ft. long, were built, connected by 399 ft. of 24-in. stone-ware pipe with cemented joints, laid through a peat bog, from which it was not deemed advisable to take water. From the filter gallery, a conduit of 24-in. stone-ware pipe was laid on a timber foundation in saturated gravel and sand 6½ to 10 ft. below the surface of the swamp for 3,074 ft. to the pump well and engine house. This was completed in November, 1874. In July, 1875, it was found that 10 per cent. of the pipes were broken by the weight of the superincumbent gravel. They were removed and replaced by a flume of 3-in. white pine plank, 2 ft. square inside, and with tongued and grooved joints.

In 1878 there were complaints of impurity of the water, and it was found that the wooden conduit had shrunk, admitting swamp water and sand through the joints. The gallery which, when first constructed in September, 1875, had yielded 1,602,000 gallons per day on a 30-hour test, with the water in the pump well 2.75 ft. above the gallery floor, yielded in July, 1878, 1,160,000 gallons per day with the water 2.30 ft. above gallery floor. The average daily consumption had increased from 200,000 gallons in 1875 to 465,000 gallons in 1878. The pumping station was removed to near the gallery, a 16-in. cast-iron force main substituted for the wooden conduit, and an additional gallery, 160½ ft. long, 6 ft. wide and 8 ft. high in the center, built from the pump-well to the old gallery. Weirs are so arranged that the water can be drawn from the new gallery at 7 ft., and from the old gallery at 6 ft. below low water in the river. This work was done after plans of Shedd & Sawyer, civil engineers. In examining the other old gallery, after the new arrangements had rendered it practicable to draw down the water, it was found that 460 ft. of its length was rendered useless by about 18 ft. of the arch having fallen in, evidently as soon as it was built, as the space had been filled with débris of brick, broken stone-ware pipes, brush, lumber and gravel. This was repaired and the whole length of galleries, 923 ft., made available. In June, 1880, the yield of the galleries was 1,000,000 gallons per day, and the daily consumption 1,200,000 gallons. On the recommendation of Gen. George S. Greene, C. E., a canal was dug along the bank of the river, parallel to and 30 to 50 ft. distant from the gallery for 150 ft. The bottom of the canal is 3 ft. below the river level and it is connected with the river. The admission of water from the river to this canal increased the yield of the galleries about 300,000 gallons daily.

The first pumping engine was a Worthington duplex compound condensing engine, with steam cylinders of 21½ and 43½ in. and water cylinders of 16 in. diameter, all of 24 in. stroke, pumping through 9,070 ft. of 14-in. cast-iron pipe to a brick well 4 ft. in diameter and 17 ft. deep on Walnut Hill. The bottom of the well is at the same level as the water surface in the reservoir, 160 ft. above low water in the river. The 14-in. force main enters this well or stand-pipe at the bottom, and a 16-in. supply main leaves it also at the bottom and leads 13,000 ft. to the reservoir, with a branch at 6,000 ft. from the stand-pipe, leading directly to the city distribution. While the engines are running, the water is pumped directly into the mains, only the surplus reaching the reservoir.

Another Worthington engine of 1,000,000 gallons daily capacity was erected at the new pumping station in 1879, and the first engine then moved to the same place.

The reservoir is in a natural basin on Fisher's Hill. It is in excavation and embankment, with the bottom covered with 12 in. and the slopes with 18 in. of clay puddle. The bottom was then covered with 4 in. of gravel concrete, and the slopes with 12 in. of broken stone, on which was laid a dry slope wall of stone 15 in. deep. During construction, springs in the gravel banks gave trouble by softening the puddle. This was obviated by making pockets of broken stone and leading the water through the puddle by gas pipe. On the completion of the work the pipes were plugged.

Distribution is by 28.5 miles of cast-iron pipe, of from 16 to 2 in. diameter, with 164 fire hydrants, 150 gates and 1,013 taps (February, 1882). The town pays $25 per year for each fire hydrant. Service pipes are now exclusively lead. Wrought-iron pipes enameled, cement lined and tarred have been used with unsatisfactory results.

The population in 1880 was 8,100. The number of taps in use at the end of each year and the daily consumption for the year have been as follows:

	Taps.	Daily consumption Gallons.
1876	587	336,452
1877	702	352,042
1878	755	462,867
1879	857	480,009
1880	930	570,738
1881	1,013	477,113

The reduced consumption in 1881 is due to inspection of fittings and cutting off waste.

In 1881 the consumption varied from 407,481 gallons in March to 588,607 gallons in August.

The total cost of construction has been $621,580.88 to Jan. 31, 1882.

The bonded debt is $593,000 at 4½ to 7 per cent. interest.

The expenses of maintenance in 1881 were $7,999.94 and the receipts, $14,199.04. The town contributes in addition, for water used for public buildings, $6,497.50.

The works are managed by three Water Commissioners. F. F. Forbes is the Superintendent.

(TO BE CONTINUED.)

CORRECTIONS AND ADDITIONS.—Carroll E. Gray, Jr., reports that there are no water-works in Alliance, Ohio; Corsicana, Texas; Danville, Ill., and Sherman, Texas. July 15, 1882, p. 239, *Cañon City, Colorado.* The works were planned by J. W. Peabody. There are 3½ miles of pipe and 21 gates, and 204 taps. The city is in lat. 38° 35' N., long. 105° 15 W., was first settled in 1858, a second time in 1866, and incorporated 1870. The water is pumped 180 ft. to the reservoir, 130 ft. above the city. July 29, p. 263, *Park City, Utah*, has 100 taps. August 19, p. 289, *Trenton, N. J.*, was settled 1679 and incorporated a city 1792. The reservoir built in 1856 holds 15,000,000 gallons, at 20 to 85 ft. above the city. The pumping machinery comprises a 10" horizontal pump erected 1853, driven by water, a 12" horizontal steam pump erected 1865, a 16" steam pump with compound beam engine erected 1875. Sept. 16, p. 328, *Agawam, Mass.* The supply is procured from 8 large springs within 300 ft., and is collected in a well 12 ft. diameter and 8 ft. deep.

Oct. 14, p. 356, *Middleton, N. J.*, has 546 taps. Oct. 21, p. 369, *Carthage, Mo.*, has 218 taps. Oct. 28, p. 373, *Camden, N. J.* The first water-works were built in 1850. The water debt is $400,000 at 7 per cent. interest. Nov. 4, p. 381, *Hot Springs, Ark.* The population by census was 3,000 in 1880. C. E. Gray, Jr., says it is 7,000 and in summer 4,000 to 5,000 more. H. N. Morphy is Secretary of the Water Co.

The receipt of statistics, as follows, is acknowledged with thanks: From James H. Ferguson, Superintendent, statistics and water rates of the water-works of Renovo, Pa. From James Wilson, Manager and Superintendent, statistics of the water-works of Kingston, Ont. From Isaac Hirsh, statistics and water rates of the water-works of Fredericksburg, Va. From John Read, Clerk and Registrar, and E. A. Nash, City Clerk, full set of reports and statistics and water rates of the water-works of Lewiston, Me. From W. R. Coats, C. E., Kalamazoo, partial statistics of the water-works of Saginaw City and Muskegan. From Travers Daniel, C. E., partial statistics of the water-works of Little Rock, Ark. From J. P. Walton, City Engineer, statistics of the water-works now building in Lincoln, Neb.

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MEASUREMENT OF WATER.

In choosing a site for a mill, or in establishing suitable machinery for the utilization of water power, the measurement of water becomes a matter of considerable importance, and a few remarks bearing on the subject may not seem out of place. The unit that is generally used in all measurements of water is a cubic foot per minute, and though other measurements of quantity in any other period of time might be used, it has been found that the above unit is most convenient. The power given out by the stream under consideration depends upon the fall of water, and in measuring the latter two things are to be considered, namely, the head and the flow. The head is measured by the ordinary operation of leveling, while the flow is determined by a variety of methods, depending to a great extent upon circumstances and upon the available means at hand with which to conduct operations. In large streams, the flow can in general be measured only directly, that is to say, the cross section of the stream is found, the velocity of the current is measured at different points in this cross section, and the sectional area is multiplied by means of these velocities. The cross section is found by measuring first the width of the stream, and then finding the mean average depth, and multiplying the two together. Suppose, for example, that we have a stream the width of which at the section selected is 15 feet. In order to find the average depth, we may divide the width, say into five equal parts, which is easily done by stretching a tape or cord across the stream, and laying off the distances required. By now measuring from the center of each of these five divisions, we ascertain the depth of water from the bottom to the surface at the different points, and by adding them together and dividing the sum by five, we obtain the average depth. Multiplying this by the width of the stream, 15 feet, we obtain the square section of the stream.

The most convenient instrument in use for the measurement of the velocity of the current is a small light revolving fan, on whose axis there is an endless screw, driving a train of wheelwork which carries indexes that record the number of revolutions made in a given time. The whole apparatus is fixed at the end of a long pole, so that it can be immersed to different depths in different parts of the stream. The relation between the number of revolutions of the fan per minute and the corresponding velocity of the current, should be determined experimentally by moving the instrument with different known velocities through a pond of still water and noting the revolutions of the fan in a given time. The fan, in practice, must be provided with a sort of hood which covers its upper portion, allowing the water to act only on the lower part. Sometimes, however, in want of an instrument of this kind, different methods must be resorted to, and among them we may mention the following as a very simple one, and one which has been successfully used in numerous experiments at Lowell. Two points are selected on the stream, and a float consisting of a small, thin piece of wood is placed in the middle of the stream, where the velocity appears to be the greatest, and a few feet above the upper point of observation. By the time it reaches this point it will have acquired the velocity of the stream, and the time occupied by the float in passing from one point to the other is carefully noted by observers stationed at the two points above mentioned. In this case, as the float has been placed in the middle of the stream, the velocity obtained is naturally the greatest velocity of the current, and as the friction of the water with the bank of the stream exerts an appreciable influence upon it, suitable deductions must be made in order to obtain approximately the average velocity of the current. It will be readily seen that the method on this account is not perfectly accurate, but in practice it has been found to yield results sufficiently satisfactory to warrant its adoption in the absence of more suitable means. If we denote the maximum velocity obtained by the above method by V, then, according to an empirical formula given by Prony, the mean velocity is

$$v = V\frac{7.71+V}{10.28+V}$$

When the stream is so small that it is practicable to make across it a temporary weir, such a weir is to be made, care being taken that it shall be perfectly water-tight at every point except at the outlet through which the whole flow of the stream is to pass. The site should naturally be chosen with a view to its tightness and security, and the channel of the stream immediately below the weir should be straight, in order that the rapid current rushing from the outlet may not injure the banks. The outlet, as described by Rankine, should be a notch or depression in the upper edge of a vertical board, for which reason weirs of this class are generally known as "notch-boards." The sides and bottom of the notch should be chamfered to an even edge with a vertical surface opposed to the water in the pond above, and in order to fulfill this condition the notch may be edged all around with thin sheet iron. The object of this is to prevent as far as possible a friction and cohesion between the water and the edge of the notch from interfering with accurate results.

A vertical scale divided into feet and decimals, and having its zero point at the level of the lower edge of the notch, is to be placed in the pond above the notch-board at some point where the water is either sensibly still or has only a slow motion, and the height at which the surface of water stands on that scale is to be noted from time to time. If we designate that height in feet by h, and the breadth of the notch by b, then the flow Q in cubic feet per second is given by the formula

$$Q = \frac{2c}{3} b h \sqrt{2gh},$$

$2g$ being 64.4 and $\sqrt{2gh}$ the velocity due to the hight h, while c is a fraction called the "co-efficient of contraction," expressing the ratio which the sectional area of the most contracted part of the jet or cascade flowing through the notch bears to the rectangle bh. In general it is adviseable that the breadth of the notch should not be less than one-fourth of that of the weir, and it may have any convenient breadth from that amount up to the entire width of the weir. The values of the co-efficient of contraction mentioned above, as given by Rankine are—for a notch of one-fourth of the width of the weir, 0.595, for a notch of the whole width of the weir, 0.667, and for any intermediate proportions the following formula is very nearly correct:

$$c = 0.57 + \frac{b}{10B},$$

B being the breadth of the weir.

Besides the variations in the co-efficient of contraction already stated, which depend upon the proportion between the breadth of the weir and of the notch, there are other variations which have been reduced to no general law, depending upon the proportions of the dimensions of the notch to each other. This inconvenience has been avoided by Professor Thomson, who has adopted a form of notch in which the section of the issuing jet is always of a similar figure, that is to say, a triangle with the apex downward. This form of notch has been found to give very satisfactory results, and the velocity of flow from it is calculated as follows; Let h be the depth in feet of the apex of the notch below the surface of the still water in the pond, and b the breadth of the notch at the level of the surface of still water; then the area of the triangle bound by that level and the edges of the notch is one-half bh, and the discharge in cubic feet per second is

$$Q = \frac{8c}{15} \times \frac{bh}{2} \sqrt{2gh}.$$

The "co-efficient of contraction," as given by Professor Thomson, are as follows: When b is equal to $2h$, c is equal to 0.595, and when b is equal to $4h$, c is equal to 0.620.

Instead of an open notch in the top of the weir board, an orifice or a row of orifices wholly beneath the level of the water in the pond may be substituted, and in that case, on account of the variations in the co-efficients of contraction which occur when the orifice has various proportions of length to breadth, and also when the ratio of the head of water above the orifice to the breadth of the orifice varies, it is desirable to select such forms and proportions as shall give rise to the smallest variations. For that purpose the orifices should be made either square or circular, and their size should be such that the height of the surface of still water in the pond shall not be less at any time than three times the diameter of the orifice. These conditions being fulfilled, let A be the area of the orifice, h the depth of its center below the upper surface of still water, and then the flow through it in cubic feet per second is

$$Q = cA\sqrt{2gh},$$

the value for c being for round orifices, 0.618, and for square orifices, 0.6. The value of $c\sqrt{2g} = 8.025c$, for round orifices, will be 4.96, and for square orifices, 4.185. No very serious error will be incurred by using these coefficients even when the height h amounts to double the diameter of the orifice.

The formulæ above given will, we think, present no serious difficulties in their application; and as they are sufficiently accurate for all practical purposes, they are considered of sufficient importance to warrant the notice which we have given them.

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PIPE-LAYING IN THE STREETS.

"This business of laying steam pipes through the street," said Deputy Commissioner Hamlin yesterday, "has caused us more trouble than I can well express. People come to us constantly with complaints about the interruption of traffic, the useless delay in repaving, and the defective manner in which the work is performed. We haven't begun to get to the end of our trouble in this matter. Gas companies, electric light companies and steam-heating companies got their franchises passed by the Board of Aldermen, and each one has a right to lay its pipe-lines through the streets, to dig and re-dig, until the streets are fairly honeycombed. Now, in regard to the steam-heating business, which is making such a row at present, there seems to be more trouble than ever before. There are two companies calling themselves the American Heating and Power Company and the New York Steam Company. Both are digging and laying their pipes at the same time, and both have secured franchises which grant them the most extraordinary powers and privileges. First one company comes along and digs and lays its pipes, and then the other, and between the two the streets are kept blocked for weeks together, and it is not unnatural that the people should kick. The Department of Public Works has no means of compelling them to work at the same time, so they go as they please. Each company has deposited bonds with the department in the sum of $50,000, by which they agree to restore the streets to exactly the same condition in which they found them. As a matter of fact, it is impossible to relay a street equally well a second time."

"But," said the reporter, "President Andrews, of the New York Steam Company, said only half an hour ago that that was gammon, and that it was quite possible."

"Well," replied the Commissioner, "I'm glad he thinks so, and we'll try to keep him up to it. We do keep them up to it as far as we can. We make them relay every paving-stone, rebuild every sewer, and restore every water-pipe or main they injure. Their gangs of men work under the eyes of our inspectors and plumbing experts, and we bring them up to the scratch every time. At first they had such confidence in the powers given them by their franchises that they were rather high and mighty, but they have come off that since. We only allow them to keep a certain length of trench open at one time; if one street is obstructed the next must always be open and great precautions are taken against possible disaster in case of fire. Beyond that we cannot go. We can't revoke their permit because they take their time about it.

"A letter in a morning paper of Sept. 26 refers to the 'niggardly manner of the New York Steam-Heating Company, which, after blockading the streets for several weeks in laying their steam-pipes, have relaid the pavement in the most outrageous manner, with a sprinkling of sand thrown over it to hide the many defects of unskilled labor.' I do not know who the writer of this, who signs himself 'Peiron,' may be, but he evidently doesn't know much about paving streets, for the sand he refers to is a necessary part of the construction of the pavement. It is true that Broadway pavements are at present in a very unsightly condition, but the settling is unavoidable, and the streets will be leveled three or four times, repaved again, and the concrete laid beneath before the work is finished. The steam companies wished to avoid the consequences of the settling and save expense by 'mounding up' the earth at first, but we would not allow this, and required them to level the streets flat and correct the defects afterward. The trenches are dug side by side, and frequently it happens that one trench is scarcely filled in when the excavation of another begins.

"Delays in the completion of the work are frequently unavoidable. For instance, lately at the head of Fulton street the New York Company put out a spur to their main at that point. A storm came and the sand was soaked, so that it was necessary to let it dry somewhat before attempting to pack it. At once there was a howl in the newspapers, and the inspector ordered the hole to be filled and paved. Since then it has settled into a rut deep enough almost to overturn a carriage. There is no use in being too quick in doing these things. Part of Broadway has been repaved no less than five times, and the street will not be in good condition again until next spring. The expenses incurred by the companies are enormous. One hundred thousand dollars per mile would, in all probability, scarce cover the outlay. One block alone in William street, between John and Fulton, will not cost less than $40,000. Gas-mains, water-pipes, and sewers have to be removed and rebuilt, elaborate machinery constructed underground, and property owners consulted about their vaults, besides the great expense of paving and repaving. The whole city is undermined by an intricate system of pipes for water, gas, and electricity, and for one company to get its pipe lines through without disturbing those of another is a matter of infinite difficulty and expense, requiring the highest order of engineering ability. As long as we convey our modern improvements underground so long must we submit to having our streets torn up."

"But," said the reporter, "how have these steam companies succeeded in getting hold of such extraordinary powers and privileges?"

"Ah," said the Commissioner, shrugging his shoulders, "there you have me—I cannot tell. These things are beyond understanding sometimes."—*N. Y. Times.*

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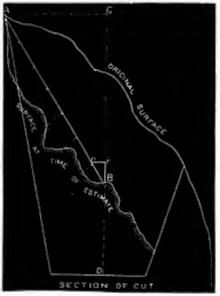
CORRESPONDENCE.

DIFFICULT EARTHWORK MEASUREMENTS.

Marlborough, N. Y., Nov. 4, 1882.

Editor Engineering News:

The assistant engineers on the N. Y., W. S. & B. Ry. have had no easy task in taking measurements for our monthly estimates, especially beside the Hudson River, where the work is almost entirely in side cutting, and the old process of averaging the cut "out to such a station," for the monthly estimate will not do; where we are at work along its whole length, as at present, we are doing in some places, and it becomes necessary to take measurements and levels over each section as originally taken, and the difference will give the "end area" at the time taken out for the month. But where we have side cuts from thirty to one hundred and thirty-five feet in height, as in Orange and Ulster counties, it is no easy or pleasant task to get these "end areas" on very deep cuts.



After running in the centers and getting the cuts thereon, I have a large square six feet on each arm, one of which I graduate into feet, tenths and hundredths, then with a fine silk cord, one end of which is looped, graduated into even 10 ft. lengths, with flannel tags thereon, I send one assistant with a rope and the cord to the upper slope, who after arriving opposite the station below, lowers the cord over the face of the cliff to another assistant, who takes the same to the center, passes an iron bar or spare drill through the loop, and we get the distance from the center from B to A very accurately, by counting the red tags, and measuring the fraction from the one nearest to the slope to the point selected by the assistant above. Then taking the square, and with a plain bob or small level hold one arm perpendicular, and note where the string crosses the other, as at a in the cut. Then, of course, the triangle Ba is equiangular and similar to the triangle BCA, and we have the following proportions:

$$Ba = \sqrt{BC^2 + a\,c^2}$$

Then $Ba : BA :: Ca : CA$ = the distance out from the center to the point selected, and $Ba : BA :: Bc : BC$, which being added to BD gives the cut at A. Then the irregularities from A to B of the surface of the rock are taken by an assistant, who lowers himself with a rope hitched from above, and with a graduated pole measures the ordinate from the chord.

I find this plan a very great convenience in restoring lost slope stakes, or even marking a grade therefrom. To expedite work when taking an estimate, I have a table calculated of lengths of hypotheneuse of a triangle, with a constant base of 6 ft., and varying by hundredths on the other arm.

Yours respectfully, R. Smith Mowry,
Assistant Engineer, N. Y., W. S. & B. Ry., Ulster County Division.

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BROCK'S BRIDGE TRUSSES.

340 South Twenty-first Street.
Philadelphia, Nov. 7, 1882.

Editor Engineering News:

As a further contribution to the articles of Mr. Brock, I desire to call attention to the fact that Mr. Finley's patent of 1808 is described and illustrated by Mr. Finley himself, and a statement made that the first patent of Mr. Templeman in the same year was a mere extension of it in the third volume, new series of the *Portfolio*, a journal published in Philadelphia and New York in 1810. This patent is especially interesting, as it describes the first modern suspension bridge, as pointed out by Mr. Bender in the first volume of the "Transactions of the American Society of Civil Engineers." That is to say, he used an auxiliary truss to stiffen the chains, which was fastened at the ends to prevent its rising. He "upset" the links at the ends, used an ultimate value for his iron of 60,000 lbs., and a factor of safety of ¼ to ⅙. He likewise found his strains and the curve of the chains by experiments with a model.

Even so late as 1828 the importance of the stiffening truss does not seem to have been appreciated in England (see pictures of the bridge at Hammersmith, in Franklin Institute Journal for April, 1828, where no truss is shown, although the text says an "ornamental meshing" would finally fill the space between suspension rods).

Among other patents destroyed, descriptions of those of Geo. W. Long, March 10, 1830, of Rich. T. L. Witty (printed Whitley in Engineering News), Oct. 14, 1835, and George Law, June 12, 1835, can be found in the Franklin Institute Journal, New Series Vols. 5, p. 380, 1830; Vol. 17, pp. 386 and 42, 1836. The first is especially interesting, as being probably the first low-strung bridge. Respectfully yours,

Thomas M. Cleeman.

THE BLUE PROCESS OF COPYING TRACINGS.

As we have had several inquiries recently in regard to the best method of copying tracings by what is known as the "blue pointing process," we will give a brief description of the method employed by us; we do not say it is the best, but it certainly is as simple as any other, and has always given us perfect satisfaction.

The materials required are as follows:

1st. A board a little larger than the tracing to be copied. The drawing-board on which the drawing and tracing are made can always be used.

2d. Two or three thicknesses of flannel or other soft, white cloth, which is to be smoothly tacked to the above board to form a good smooth surface on which to lay the sensitized paper and tracing while printing.

3d. A plate of common double-thick window glass of good quality, slightly larger than the tracing which it is wished to copy. The function of the glass is to keep the tracing and sensitized paper closely and smoothly pressed together while printing.

4th. The chemicals for sensitizing the paper. These consist simply of equal parts, by weight, of citrate of iron and ammonia and red prussiate of potash. These can be obtained at any drug store. The price should not be over 8 or 10 cents per ounce for each.

5th. A stone or yellow glass bottle to keep the solution of the above chemicals in. If there is but little copying to do, an ordinary glass bottle will do, and the solution made fresh whenever it is wanted for immediate use.

6th. A shallow earthen dish in which to place the solution when using it. A common dinner plate is as good as anything for this purpose.

7th. A brush, a soft paste brush about 4 in. wide, is the best thing we know of.

8th. Plenty of cold water in which to wash the copies after they have been exposed to the sunlight. The outlet of an ordinary sink may be closed, by placing a piece of paper over it with a weight on top to keep the paper down, and the sink filled with water, if the sink is large enough to lay the copy in. If it is not, it would be better to make a a water-tight box about 5 or 6 in. deep, and 6 in. wider and longer than the drawing to be copied.

9th. A good quality of white book paper.

Dissolve the chemicals in cold water in the following proportions: 1 ounce of citrate of iron and ammonia, 1 ounce of red prussiate of potash, 8 ounces of water. They may all be put into a bottle together and shaken up. Ten minutes will suffice to dissolve them.

Lay a sheet of the paper to be sensitized on a smooth table or board; pour a little of the solution into the earthen dish or plate, and apply a good even coating of it to the paper with the brush; then tack the paper to a board by two adjacent corners, and set it in a dark place to dry; one hour is sufficient for the drying: then place its sensitized side up on the board on which you have smoothly tacked the white flannel cloth; lay your tracing which you wish to copy on top of it; on top of all lay the glass plate, being careful that paper and tracing are both smooth and in perfect contact with each other, and lay the whole thing out in the sunlight. Between 11 and 2 o'clock in the summer time, on a clear day, from 6 to 10 minutes will be sufficiently long to expose it; at other seasons a longer time will be required. If your location does not admit of direct sunlight the printing may be done in the shade, or even on a cloudy day; but from one to two hours and a half will be required for exposure. A little experience will soon enable any one to judge of the proper time for exposure on different days. After exposure, place your print in the sink or trough of water before mentioned and wash thoroughly, letting it soak from 3 to 5 minutes. Upon immersion in the water, the drawing, hardly visible before, will appear, in clear white lines on a dark blue ground. After washing, tack up against the wall, or other convenient place, by the corners to dry. This finishes the operation, which is very simple throughout.—*The Locomotive.*

[A valuable paper on Blue Process Printing was published in the "Journal of the Association of Engineering Societies," for August, 1883, for sale by the Secretary of the association, H. G. Prout, No. 12 Barclay street, New York.—Ed. Engineering News.]

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The Cost of Electric Lighting.—The cost of the experiments in electric lighting which have been carried on for some time past at four stations of the Bergisch-Märkische Railway (Germany) at Hagen has been recently published. The outlay, inclusive of the steam-engines, was £1,005 4s., and the cost of 15 lights, replacing 45 gas-lamps, was in June 2s. 6d., and in January 1s. 9½d., per light per hour, while the expense formerly for gas was 1s. 5½d. per lamp per hour. At Alberfeld the outlay was, exclusive of the engine, £413 12s. The six electric lights, which took the place of 23 gas-lamps, cost 1s. 10d. in June, and 1s. 1½d. in January per light per hour. At Dusseldorf the outlay was about £750. The cost per lamp per hour is 4½d. At Hochdahl, £169 8s. had been expended, while each light cost from 1¾d. to 1½d. per hour. But it is expected that, with the reduction in the price of carbons, the cost will be lowered to 1¼d. or 1½d. per light. It should be added that the system employed at Hochdahl is that of Schukert, while at the other three stations Siemens' differential lamps are used.

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S. D. V. BURR..............ASSOCIATE EDITOR.

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EDITORIAL ANNOUNCEMENTS.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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STOPPING WORK ON THE HUDSON RIVER TUNNEL.—On last Monday all work was stopped on the Hudson River tunnel. All connected with the work were laid off, with the exception of enough to run the air compressors, in order that the completed sections may not be flooded.

What caused this step we could not learn, and as the meager information we did obtain led us to believe that it was purely a private matter and had no connection with the engineering features of the work, our "search after knowledge" was not characterized by much vigor. The work has been progressing very successfully all the summer on both sides of the river, and, notwithstanding the difficulties encountered on this side, the aggregate number of lineal feet of finished tunnel is large. On the New Jersey side the heading of the north tunnel is 1,542 ft. from the shaft, and the south tunnel 570 ft.; on this side the heading is 74 ft. out.

The stoppage may be but for a short time, and it may continue all winter. Considering the financial ability of the Construction Company and the present favorable aspect of the work, renewed exertions will be inaugurated soon.

EVERY once in a while the superintendent of a water-works wants to know what the practice in other works is with reference to some detail of the operation of the works. He finds that his company or his commissioners think that he is extravagant, perhaps, and that the service is costing too much. If he could only have some reliable statistics of other places to lay before them to show that this was not the case, it would be worth a good deal to him. Perhaps it would be worth his situation.

Such a collection of statistics we are now placing in the hands of subscribers to ENGINEERING NEWS. We have printed statistics of 405 water-works, furnished by the officers of the works. There are about 260 more towns from which no response has been received. As soon as the returns can be had from them, the whole book will be issued, with tables in which the principal data will be compared and rendered easily understood. We ask every one of our readers to aid the author in his efforts to get together the desired information. We particularly ask every water-works engineer, contractor and superintendent to send all the facts relating to works he has designed, built or managed, in order that the "History and Statistics of American Water-Works" may be complete and thorough.

THE publication last week of the list of towns having water-works, and from which no returns have been received, has excited much interest and over 60 blanks have already been sent to persons who have asked for them. This is gratifying, and we hope that no effort will be spared by every one who is interested in the construction and management of water-works, to secure full and correct data for Mr. Croes' great work.

We ask every water-works superintendent to devote one hour to putting on paper the few bare facts asked for. For ninety per cent. of the towns unheard from, this time will amply suffice to give very full data. One superintendent wrote to Mr. Croes that he had not time to answer the questions on the blank. We are sure he was mistaken, for there is no superintendent in the United States who ought not to be able to answer all the questions by giving ten minutes a day to it for a week. In the case in question we really believe that the gentleman had spent more time in reading Mr. Croes' letters to him than he would have needed to answer the questions in the first place. We may add that very complete and excellent statistics of those works were procured from another source, and such will be the case everywhere, if the officers of the works do not send the information themselves.

FORESTRY BULLETIN No. 22.

SPECIFIC GRAVITY AND ASH OF THE WOODS OF THE UNITED STATES.

Published by Census Bureau.

This contains the report of the special agent in charge of the physical and chemical work of the forestry department of the census office. The results of his determinations of the specific gravity, percentage of ash and comparative fuel values are given for about five hundred kinds of timber grown in different parts of the country under different conditions of soil and climate. The specimens were made 100 millimeters long and about 35 millimeters square, and were dried at 100 degrees centigrade until they ceased to lose weight, and were simply measured and weighed to find the specific gravity. Two determinations of ash were made by burning small dried blocks in a muffle furnace at a low temperature. The comparative fuel values are calculated from the specific gravity and the percentage of ash, and are based on the hypothesis that the fuel value of the combustible matter in all woods is the same. The table gives also the botanical name, the common name, and the region where grown, of each specimen investigated. Out of the five hundred kinds there are sixteen which have, when perfectly dry, a specific gravity greater than unity. Whatever may be thought of the propriety of entrusting the census bureau with scientific investigations of this kind, there can be no doubt but that such exhaustive reports will be very valuable. We hear it rumored that tables relating to the strength of wood and stone will also be published.

RAILWAY COMMUNICATION BETWEEN NORTH AND CENTRAL AND SOUTH AMERICA.

Hinton Rowan Helper, of St. Louis, is well known as the zealous advocate of the "back-bone" or "three Americas" railroad, which he is desirous of building between Hudson's Bay and Patagonia, and the pamphlet with the above title contains his latest contribution to the subject. It is in the shape of a petition to Congress asking for the appointment of a commissioner to visit South America and make the necessary preliminary negotiations and inquiries. Some years ago he paid five thousand dollars for the best essays on this interesting subject, and published them in a book, copies of which he forwarded to all the Senators and Representatives at Washington, many of whom, he complains, have no recollection of having received it. In his memorial he urges the scheme with many arguments more or less forcible. Was it prudent, he asks, for us to open railroad communication with Boston and New Orleans? Equally prudent, he replies, will it be for us to establish regular railway intercourse with the capitals of Ecuador and Paraguay! "In a general way," he claims, "every fact, argument and suggestion that was ever urged in the interest of any railroad whatever, may be legitimately urged, with at least tenfold force, in the interest of the inter-continental railway here proposed."

PERSONAL.

MR. JOSEPH FRANKLIN has been appointed Superintendent of the New York Central & Hudson River Railroad, in place of Mr. J. M. TOUCEY.

MR. W. D. CLARK, Superintendent of Construction of the new Court-house at Denver, Colo., has resigned his position, the Capitol Board of Building Commissioners of the State of Texas having appointed him Superintendent of Construction in the erection of the new Capitol building at Austin.

MR. J. W. SEWALL, Old Town, Me., is Engineer in charge of the Waring system of sewerage now being introduced into Keene, N. H., by the Drainage Construction Co. W. F YATES, of Memphis, Tenn., and P. F. BABBIDGE, of Old Town, Me., are first assistant engineers upon the same work.

TWENTY-FIVE years ago HENRY VILLARD, the President of the Northern Pacific, was in Racine and engaged in a newspaper enterprise. To obtain money he gave a note for $300 which was indorsed by SAMUEL RITCHIE. VILLARD was unable to meet his obligation and Mr. RITCHIE was obliged to pay it. A few days ago he wrote to VILLARD and offered to surrender the note for $500. Mr. RITCHIE received a letter from Mr. VILLARD with a check for $1,000. The latter supposed the claim had been paid years ago.

NEW PUBLICATIONS.

Proceedings of the Association of Municipal and Sanitary Engineers and Surveyors. London, 1882.

England is *par excellence* the country of sanitary reform. The Public Health Acts, the reports of numerous eminent Commissioners appointed by the government to inquire into almost every phase of sanitary science, the various societies organized to investigate and discuss co-relative questions, far exceed in number those in any other country.

The above publication contains the proceedings of a society composed of civil engineers and surveyors holding permanent appointments under the municipal corporations in England, numbering nearly 200 members and representing nearly every prominent town. We may therefore expect to find in it a fair expression of opinion regarding the most advanced principles and practices of sanitary engineering. Besides containing the results of actual experience together with deductions, we also find, as is natural, some extravagant notions on the capabilities of engineering and of certain special devices to effectually overcome the pollution of air, water and soil. But the careful student, aided by the interesting and very full discussions on nearly every paper, will readily eliminate the fancies from the facts.

On the whole we know of no other society which contributes as much material towards the advancement of sanitary engineering.

The last three volumes contain papers among others on the following topics: Descriptions of the sewage works at Hanley, Barnsley, Shildon, West

Derby, Dewsbury and Leistrum Beck. Separate papers on The Separate System of Town Drainage. Papers on Sewerage details, viz.: Sluices, Penstocks, Junction Blocks and Connections with House Drains, Sanitary Supervision of Dwellings, Sewer Ventilation, Sewer Gas Nuisance and its Remedy, Shaw's Ejector System, Hanson's Sewage Process, Rivers Conservancy and Floods Prevention Bill, Sanitary Legislation, Roadways, Wood Pavements, Steam Road Rolling, Asphalt and its application to Street Paving, Street Lighting of the Future, etc., etc.

THE NEW PATENT LAW OF BRAZIL.

The new law of industrial privileges, or patents, was finally passed by the Chamber of Deputies, in third reading, on the 27th ult., there remaining only the formal signing of the decree by the Emperor to give full and legal effect to the measure. The law was originally introduced into the Chamber by the late Minister of Agriculture Buarque de Macedo, where it was passed on the 23d of December, 1880. The narrow, stringent provisions of the measure, however, found little favor in the Senate, where some months since it was substituted by a new and better measure. This substitute was finally passed by the Senate on the 20th of July last, and was then returned to the Chamber for concurrence. The full text of the law is as follows:

The General Assembly decrees:

ARTICLE I.

In the concession of a patent to the author of any invention or discovery, the law guarantees the right of property and exclusive use.

SECTION 1. For the effects of this law the following shall constitute an invention or discovery:

1st. The invention of new industrial products;

2d. The invention of new processes or the new application of known processes for obtaining an industrial product or result;

3d. The improvement of an invention already privileged, if it shall facilitate the manufacture of the product or the use of the privileged invention, or if it shall increase its utility.

Those industrial products, processes, applications and improvements shall be considered new which up to the application for a patent have never, within or without the empire, been employed or used, and of which can neither be found descriptions nor publications of the method by which they can be employed or used.

SEC. 2. The following inventions cannot be made the object of a patent:

1st. Those contrary to law or morality;

2d. Those dangerous to public security;

3d. Those noxious to public health;

4th. Those which do not offer a practical industrial result.

SEC. 3. The patent will be conceded by the executive power, after the fulfilment of the formalities prescribed in this law and in its regulations.

SEC. 4. The exclusive privilege of a principal invention will only be valid up to fifteen years, and that of an improvement to the invention, conceded to the author, will terminate at the same time with it.

If public necessity or utility require the free use (*vulgarisacao*) of an invention, or its exclusive use by the state, during its privilege, the patent can be disappropriated, in conformity with the legal formalities.

SEC. 5. The patent is transmissible by any of the modes of cession or transference recognised by law.

ARTICLE II.

Inventors receiving privileges in other countries can obtain a confirmation of their rights in this empire, provided that they fulfil the formalities and conditions of this law, and observe the further dispositions in force applicable to the case.

The confirmation will give the same right as a patent conceded in the empire.

SEC. 1. The priority of the property right of that inventor who, having solicited a patent from a foreign country, shall make a similar petition to the imperial government within seven months, will not be invalidated by facts which may occur during this period, to wit, another similar petition, the publication of the invention, and its use or employment.

SEC. 2. To the inventor who, before obtaining a patent, desires to experiment in public with his inventions, or wishes to exhibit them in an exposition, official or officially recognised, will be granted a title provisionally guaranteeing to him his right of property for a specified time, and with the formalities required.

SEC. 3. During the first year of the privilege only the inventor himself, or his legal successors, can obtain a privilege for improvements on his own invention. It will be permitted to third parties, however, to present their petitions within the said period in order to establish their rights.

The inventor of an improvement cannot engage in the industry benefited while the privilege for the principal invention lasts, without an authorization from its author; nor can the latter employ the improvement without an accord with him.

SEC. 4. If two or more persons solicit a privilege at the same time for an identical invention, the Government, except in the hypothesis of Section 1 of this article, will require that they shall previously determine the priority, either by means of an accord or in a competent court.

ARTICLE III.

The inventor who seeks a patent will deposit in duplicate in the department which the Government shall designate, within a closed and sealed envelope, a report in the national idiom, describing the invention with accuracy and clearness, its purpose and the method of using it, with the plans, designs, models and samples which may contribute to an exact understanding of the invention and the elucidation of the report, so that any person cognisant of the subject can obtain or apply the result, means or product of which it treats.

The report shall clearly specify the characteristic features of the invention (*privilegio*).

The extension of the right of patent will be determined by the said features, mention of this being made in the patent.

SEC. 1. With the document for deposit will be presented the petition, which should be limited to one single invention, specifying its nature and its purposes or applications, in accordance with the report and with the documents deposited.

SEC. 2. If it shall appear that the subject of the invention involves an infraction of Sec. 2, Art. 1, or has for its object alimentary, chemical or pharmaceutical products, the Government will order a previous and secret examination of one of the copies deposited, in conformity with the regulations to be issued; and in accordance with the result it will or will not concede a patent.

From a negative decision there will be recourse to the Council of State.

SEC. 3. With the sole exception of the cases mentioned in the preceding paragraph, the patent will be issued without previous examination.

In it the object of the privilege will always be designated in a concise manner, with a reserve of the rights of a third party, and of the responsibility of the Government, in respect to the originality or utility of the invention.

In the patent of an inventor privileged outside of the empire, it will be declared that it is valid so long as the foreign patent is in force, never exceeding the specified period of Sec. 4, Art. 1.

SEC. 4. Beside the expenses and fees incurred the patentees shall pay a tax of 20$ for the first year, 30$ for the second, 40$ for the third, increasing 10$ for each year that shall ensue over the preceding annuity for the whole period of the privilege. In no case will the annuities be refunded.

SEC. 5. To the privileged inventor who improves his own invention will be given a certificate of improvement which will be appended to the respective patent.

For this certificate the inventor will pay once for all an amount corresponding to the annuity which has become due.

SEC. 6. The transfer or cession of patents or certificates will not enter into effect until it has been registered in the Bureau of Agriculture, Commerce, and Public Works.

ARTICLE IV.

The patent having been issued, and within a period of thirty days, the opening of the deposited envelopes will take place with the formalities which the regulations shall specify.

The report shall be immediately published in the *Diario Official*, and one of the copies of the designs, plans, models or samples will be opened for the inspection of the public and for the study of interested parties, it being permitted to take copies.

SEC. 1. In case the previous examination of which Sec. 2, Art. III., treats, has not taken place, the Government, having published the report, will order a verification, by means of experiments, of the requisites and conditions required by law for the validity of the privilege, according to the method established for such examination.

ARTICLE V.

A patent will become of no effect if it is annulled or shall lapse.

SEC. 1. The patent will become null:

1st. If in its concession any one of the requirements of Sections 1 and 2 of Art. 1 has been infringed.

2d. If the patentee did not have priority;

3d. If the patentee shall have falsified the truth or concealed essential matter in the report descriptive of the invention, whether in its object or in the manner of using it;

4th. If the name of the invention shall be, with fraudulent purpose, diverse from its real object;

5th. If the improvement shall not have the indispensable relation with the principal industry, and can be constituted a separate industry, or there shall have been priority (*pretericao*) in the preference established by Art. II., Sec. 3.

SEC. 2. The patent will lapse in the following cases:

1st. The patentee not making effective use of the invention within three years, counting from the date of patent;

2d. The patentee suspending the effective use of the invention for more than one year, except by cause of *force majeur* judged sufficient by the Government, after consulting the respective section of the council of state;

By use is understood in these two cases, the effective exercise of the privileged industry, and the supply of the products in proportion to their employment or consumption.

It being proved that the supply of the products is evidently insufficient for the needs of employment or consumption, the privilege can be restricted to a zone determined by an act of the Government, with the approval of the legislative power.

3d. The patentee not paying the annuity within the terms of the law;

4th. The patentee, residing outside of the empire, not constituting an accredited agent to represent him before the Government, or in court;

5th. Through the express renunciation of the patent;

6th. The patent or foreign title upon an invention also privileged in the empire, being discontinued;

7th. The term of the privilege having expired.

SEC. 3. The nullity of a patent or of a certificate of improvement will be declared by a decision of the commercial court (*juizo commercial*) of the capital of the empire, by means of the summary process of decree No. 737, of Nov. 25, 1850.

The following are competent to promote an action for nullity:

The solicitor of the treasury (*procurador dos feitos da fazenda*) and his assistants, to whom will be forwarded the documents and proofs, corroborative of the infraction;

And any interested party with the assistance of that official and his assistants.

An action of nullity in the cases of Art. I. Sec. 2, Nos. 1, 2 and 3, having been begun, the execution of the patent and the use or employment of the invention will remain suspended until the final decision.

If the patent shall not be annulled, the patentee will be reinvested in its enjoyment with the integrity of the term of privilege.

SEC. 4. The lapse of patents will be declared by the Minister and Secretary of State for the affairs of agriculture, commerce and public works, with recourse to the Council of State.

ARTICLE VI.

The following will be considered infractors of the privilege:

1st. Those who, without license from the patentee, manufacture the products, or employ the processes, or make the applications which are the object of the patent;

2d. Those who import, sell, or expose for sale, conceal or receive for the purpose of sale, counterfeited products of the privileged industry, knowing what they are.

SEC. 1. The infractors of a privilege will be punished, in favor of the public coffers, with a fine from 500$ to 5,000$; and in favor of the patentee with from 10 to 50 per cent. of the damage caused, or which may be caused.

SEC. 2. The following will be considered as aggravating circumstances:

1st. The infractor to be or to have been an employé or workman in the establishment of the patentee.

2d. The infractor to associate with an employé or workman of the patentee for acquiring knowledge of the practical method of obtaining or employing the invention.

SEC. 3. The cognizance of infractions of a privilege belongs to the *juizes de direito* (district judges) of the *comarcas* (districts) where they reside, who will issue, on the petition of the patentee or his legal representative, the warrants of search, apprehension and deposit, and will prescribe the preparatory or preliminary proceedings of the process.

The sentence will be governed by law No. 562, of July 2, 1850, and by decree No. 707, of Oct. 9, of the same year, so far as they apply to the case.

The products of which Nos. 1 and 2 of this article treat, and the respective instruments and apparatus, will be adjudged to the patentee by the same sentence which condemns the authors of the infractions.

SEC. 4. The process will not hinder an action by the patentee to secure indemnification for damage caused or which may be caused.

SEC. 5. Commercial jurisdiction is sufficient for all the causes relative to industrial privileges, in conformity with this law.

SEC. 6. The following will be punished, with a fine of from 100$ to 500$, in favor of the public coffers:

1st. Those who announce themselves as possessors of a patent, using the emblems, marks, inscriptions or labels upon products or objects prepared for commerce or exposed for sale, as if they had been privileged.

2d. Those inventors who continue to exercise an industry, as privileged, the patent being suspended, annulled or lapsed.

3d. Those privileged inventors who, in prospectuses, advertisements, inscriptions, or by any mode of public notice shall mention patents without designating the special objects for which they were obtained.

4th. Those professional men or experts who, in the hypothesis of Sec. 2, of Art. III., cause the general diffusion of the secret of the invention, without prejudice in such case, to the criminal or civil actions which the laws permit.

SEC. 7. The infractions of which the preceding paragraph treats will be prosecuted and judged as political crimes, in conformity with the legislation in vigor.

ARTICLE VII.

When a patent shall be conceded to two or more co-inventors, or when it becomes common by a title of gift or succession, each one of the co-proprietors can use it freely.

ARTICLE VIII.

If a patent shall be given or left in usufruct, the usufructuary will be obliged, when his rights cease through the the extinction of the usufruct or termination of the term of privilege, to give to the owner of the property the value at which it shall be estimated, calculated with relation to the time which the usufruct has lasted.

ARTICLE IX.

The patents of invention already conceded will continue to be governed by the law of Oct. 28, 1830, there being applied to them the dispositions of Art. V., Sec. 2, Nos. 1 and 2, and of Art. VI., of this present law, with the exception of pending processes or actions.

ARTICLE X.

All dispositions to the contrary are hereby revoked.—*Rio News, Oct. 5.*

◆

SOME BIG THINGS.

The largest suspension bridge will be the one now building between Brooklyn and this city. The length of the main span is 1,595 ft. 6 in. The entire length of the bridge is 5,989 ft.

The Pennsylvania Railroad's new locomotive Jumbo has seven-feet driving wheels, and has drawn a train from Philadelphia to Jersey City, a distance of ninety miles, in eighty minutes.

Fortress Monroe is the largest single fortification in the world. It has already cost the government over $3,000,000. The water battery is considered one of the finest military works in the world.

The loftiest active volcano is Popocatepetl (smoking mountain), thirty-five miles southwest of Pueblo, Mexico. It is 17,784 ft. above the sea level, has a crater three miles in circumference and 1,000 ft. deep.

The longest span of wire is used for a telegraph in India over the river Kistnah, between Bezorah and Seetanagrum. It is more than 6,000 ft. long, and is stretched between two hills, each 1,200 ft. high.

The largest university is Oxford, in Oxford, England. It consists of twenty-five colleges and five halls. Oxford was the seat of learning in the time of Edward the Confessor. It claims to have been founded by Alfred.

The largest ship is the Great Eastern. She is 680 ft. long, 83 ft. broad and 60 ft. deep, being 22,927 burden, 18,915 gross and 13,344 net register. She was built at Millwall, on the Thames, and was launched Jan. 31, 1857.

The most extensive park is Deer Park, in the environs of Copenhagen, Denmark. The enclosure contains about 4,200 acres, and is divided by a small river. The largest pleasure ground in this country is Fairmount Park, Philadelphia, which contains 2,740 acres.

The largest body of fresh water on the globe is Lake Superior. It is 400 miles long, 160 miles wide at its greatest breadth, and has an area of 32,000 square miles. Its mean depth is said to be 200 ft., and its greatest depth about 900 fathoms. Its surface is 635 ft. above the sea.

The largest tunnel in the world is that of St. Gothard, on the line of railroad between Lucerne and Milan. The summit of the tunnel is 990 feet below the surface at Audermatt, and 6,600 feet beneath the peak of Kastelhorn, of the St. Gothard group. The tunnel is 26¼ feet wide, and 19 feet 10 inches from the floor to the crown of the arched roof. It is 9¼ miles long, 1¼ miles longer than the Mt. Cenis tunnel.

The most extensive cavern is the Mammoth Cave in Edmondson County, Ky. It is near Green River, six miles from Cave City, and about twenty-eight miles from Bowling Green. The cave consists of a succession of irregular chambers, some of which are large, situated on different levels. Some of these are traversed by navigable branches of the subterranean Echo River. Blind fish are found in its waters.

The largest trees are the mammoth trees in California. One of a grove in Tulare County, according to measurement made by members of the State Geological Survey, was shown to be 276 feet high, 106 feet in circumference at base, and 76 feet at a point 12 feet above the ground. Some of the trees are 376 feet high and 34 feet in diameter. Some of the largest that have been felled indicate an age of from 2,000 to 2,500 years.

The largest inland sea is the Caspian, lying between Europe and Asia. Its greatest length is 760 miles, its greatest breadth 270 miles, and its area 180,000 square miles. Great Salt Lake, in Utah, which may be properly termed an inland sea, is about 90 miles long and has a varying breadth of from 20 to 25 miles. Its surface is 4,200 feet above the sea, whereas the surface of the Caspian is 84 feet below the ocean level.

The largest empire in the world is that of Great Britain, comprising 8,557,658 square miles, more than a sixth part of the land of the globe, and embracing under its rule nearly a sixth part of the population of the world. In territorial extent the United States ranks third, containing 3,580,242 square miles, including Alaska; in population it ranks fourth with its 50,000,000 people. Russia ranks second: 8,352,940 square miles.

The highest monolith is the obelisk at Karnak, Egypt. Karnak is on the east bank of the Nile, near Luxor, and occupies a part of the site of an ancient Thebes. The obelisk is ascribed to Hatasu, sister of Pharaoh Thothmes III., who reigned about 1600 B. C. Its whole length is 122 feet, its weight 400 tons. Its height, without pedestal, is 108 feet 10 inches. The height of the obelisk in Central Park, without pedestal, is 68 feet 11 inches, its weight about 168 tons.

The Chinese wall is the largest wall in the world. It was built by the first emperor of the Tsin dynasty, about 220 B. C., as a protection against Tartars. It traverses the northern boundary of China, and is carried over the highest hills through the deepest valleys, across rivers and every other natural obstacle. Its length is 1,250 miles. Including a parapet of 5 feet, the total height of the wall is 20 feet; thickness at the base 25 feet and at the top 15 feet. Towers or bastions occur at intervals of about 100 yards.

The largest library is the Bibliotheque National in Paris, founded by Louis XIV. It contains 1,400,000 volumes, 300,000 pamphlets, 175,000 manuscripts, 300,000 maps and charts, and 150,000 coins and medals. The collection of engravings exceeds 1,300,000, contained in some 10,000 volumes. The building which contains these treasures is situated on the Rue Richelieu. Its length is 540 ft., its breadth 130 ft. The largest library in New York, in respect of separate works, is the Astor. About 190,000 volumes are on its shelves.

Among the most remarkable natural echoes is that of Eagle's Nest, on the banks of Killarney, in Ireland, which repeats a bugle call until it seems to be sounded from 100 instruments; and that on the banks of the Naha, between Bingen and Coblentz, which repeats a sound 17 times. The most remarkable artificial echo known is that in the Castle of Simonetta, about two miles from Milan. It is occasioned by the existence of two parallel walls of considerable length. It repeats the report of a pistol sixty times.

The largest bell in the world is the great bell of Moscow, at the foot of the Kremlin. Its circumference at the bottom is nearly 68 ft., and its height more than 21 ft. In its stoutest part it is 23 in. thick, and its weight has been computed to be 443,772 lbs. It has never been hung, and was probably cast on the spot where it now stands. A piece of the bell is broken off. The fracture is supposed to have been occasioned by water having been thrown upon it when heated by the building erected over it being on fire.

The big bridge across the Kinzua chasm on the Erie extension, 15 miles south of Bradford, Pa., was completed about two weeks ago, and trains will soon be running over it. The bridge is a symmetrical iron structure, and is the highest in the world, the centre span being 301 ft. in height, and the length of the structure is 2,060 ft. It was built by the Keystone Bridge Co. of Phoenixville, Pa. The completion of this bridge gives the New York, Lake Erie & Western Railroad direct communication to the coal field of western Pennsylvania.

The largest cathedral in the world is St. Peter's in Rome. From the laying of its foundation in 1450 until its dedication, 170 years were consumed in its erection; and if we include the work done under Pius VI., three and a half centuries passed before it was complete, during which time 43 popes reigned. The dimensions of the church are: length of the interior, 613½ ft.; of transom from wall to wall, 446½ ft.; height of nave, 152½ ft.; of side aisles, 47 ft.; width of nave, 77-89 ft.; of side aisles, 33½ ft.; circumference of pillars which support the dome, 253 ft. The height of the dome from the pavement to the base of the lantern is 405 ft.—to the top of the cross, 448 ft. The dome is encircled and strengthened by six bands of iron. A stairway leads to the roof, broad and easy enough to allow a horse and team to ascend. The annual cost of keeping the church in repair is 30,000 scudi.—*N. Y. Sun.*

HOUSEHOLD ECONOMY IN NEW YORK.

There is no prospect, in fact, of desirable flats—that is, apartments of any size, convenient, light and airy—being other than expensive in this city. It is twelve years since the first apartment-houses were built; hundreds of them of divers grade have been put up all over town; but those capable of accommodating a small family, with an elevator and pleasant well-ventilated rooms, cannot be had for less than from $1,500 to $2,000. There are flats in poor quarters that rent for from $600 to $800, but they usually have dark chambers, they are ill-arranged and are seldom really wholesome. As a generalization, it may be said that reasonable apartments are not good, and that good apartments are not reasonable. The fond anticipations cherished eight or ten years ago that a nice, healthful apartment might be procured for from $500 to $600 annually have long been dispelled. They who have no more than that to spend for a home, so called, are obliged to put up with sundry discomforts, and to jeopard their health more or less by sleeping in dark, close chambers.

It would seem as if economy of any kind were impracticable in this the costliest of capitals. The mere decencies of life are well nigh beyond the reach of men dependent on salaries or ordinary incomes. The average earnings here of men even of education and taste are not, it is alleged, in excess of $1,500 to $1,600, and as the majority of them have families (the unwritten law of Manhattan demands that no couple, unless financially independent, shall have more than two children), they are forced into a ceaseless contest for self-sustainment. They toil through life, endure vexation, disappointment, tribulation, pain, and quit the world leaving no provision for their families, but generally in debt. Comparatively few men who can command credit die, it is said, with all their liabilities discharged. The proportion of New Yorkers of whom this is true must be larger than of other citizens, for credit here is easily got, and the cost of living is far greater than elsewhere.

What can be expected of a husband and a father who can earn no more than $1,500 or $1,600? How is it possible for him to stem the current always running so strong against him, especially against the refined and sensitive poor of Anglo-Saxon strain? It is clear that he can not live in the city proper; he must pitch his tent, as it may justly be styled, in the rear of Brooklyn, along the lines of the New Jersey railroads, among the sand knolls of Long Island, or amid the pastures of Westchester. He must come and go daily to and from his business in every sort of weather, keeping mind and nerves on the stretch lest he miss the boat or train. His wistful life is regulated by schedule time; he is ever hurried, planning to save a few minutes, and yet wasting, from the perpetual stress of circumstance, his entire years. He has no leisure, no repose; he is absorbed in town, feverish in the country; he sees little of his family, nothing of his friends; he is engrossed with his petty affairs, which he may despise, but which he can not afford for an hour to neglect. His life is a dull, wearisome round, his most serious thought how he shall get on, and while still thinking of it the cord snaps and the end comes. He has done his work. True; but was it worth doing? After years of grinding labor, what has he achieved; where is his recompense? He has been striving faithfully for his family, and at the close he leaves them the discouragement of his example, and probably a legacy of debt. Such is the inspiring destiny of the average New Yorker. Verily is honesty its own and only reward!—*Junius Henri Browne, in Harper's Magazine for November.*

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THE BENEFIT OF SEWERAGE.

Crowded centers afford the most striking illustration of what can be done both in the way of developing disease-generating germs, and also in destroying them or averting their effects, as shown by the death statistics of cities under varying conditions of sanitary efficiency. Thus in London the death rate during the five years following 1869 was 27.0; during the same number of years ending in 1881, it was 23, and last year it was only 21.7. The city of Munich offers perhaps the most striking illustration of the effects of sanitary efficiency. Between 1854 and 1859, when there was a total absence of all attempts at sanitation, the death rate from enteric fever was 24.2 per million; from 1860 to 1865, when the porous sides of cesspools were cemented to stop the filtration of sewage into the ground, it was reduced to 16.8; from 1866 to 1873, when the drainage system was partly complete, it was 13.3, and by 1880, when the works were complete, it had sunk to 8.7. In the same way the statistics of many other cities might be adduced, to show the results which follow the prompt removal of sewage, instead of allowing it to remain and develop into active energy the latent forms of elementary life with which it teems.

NOTES.

Ship Canals.

The old-fashioned canals, capable only of carrying barges, which won such renown for the Duke of Bridgewater and Brindley, the engineer, a century ago, have now become rather obsolete. If they did not exist no one would construct them, but, as they are made, they form a useful adjunct to the railway for the carriage of heavy or bulky materials of small value. But for the ship canal a new era is opening. Africa has for ten years been an island, and if the Siamese link which binds together those two dissimilar twins, North and South America, is not shortly severed, the delay will be due rather to climatic obstacles or political complications than to engineering incapacity. The exigencies of railway making—the embankments, and cuttings, and tunnels—have taught the modern engineer how to "shift dirt" on a scale which would have been deemed miraculous by the shrewd heads which set "navigators" to work to dig out our old canals, and therefore no task of this sort transcends human ambition. The constantly increasing use of steam also, to the supersession of sailing ships, renders canals of more practical importance than formerly. A sailing ship, unaided by a fair wind, would naturally make very slow progress along a narrow cut of water, whereas a steamer—on account of the smoothness of the surface—shows to better advantage there than on the sea. Hence we have ambitious projects of ship canals in various quarters. France desire to islandise herself by cutting a broad, deep dyke from Bordeaux to the Mediterranean; Germany proposes a water-way from the Baltic to the North Sea, across Holstein, thus rendering herself independent of a possible Danish blockade of the Sound; Manchester plans to become a seaport, to bring the briny ocean close to Market street, and leave her old rival Liverpool stuck in the mud. This latter project is to be achieved either by a canal from the Mersey, or, better still, by utilizing the neglected estuary of the Dee. And if Manchester succeeds in her scheme, why not extend the canal on to Birmingham, and thence to London? Before many years we may see one of the monsters of the deep which are owned by the Cunard Company or the P. and O. steaming through the green meadows of Warwickshire.—*London Illustrated News.*

What is Sewer Gas?

What is sewer gas? This term has been employed a long time by chemists, sanitarians, plumbers and others to indicate the ordinary emanations from sewers; but recently certain gentlemen have taken exceptions to the term, denying that there is any such thing as sewer gas "having a peculiar and definite composition." This is undoubtedly true, and it is probable that no intelligent man or educated physician ever thought otherwise. What has been called "sewer gas" is composed of air, vapor and gases in constantly varying proportions, together with living germs—vegetable and animal—and minute particles of putrescent matter. In short, it is composed of whatever is sufficiently volatile or buoyant to float in the atmosphere, and in consequence of which buoyancy it is permitted to escape through the various sewer-outlets. The term is, in this sense, well understood, and it is, moreover, just as correct as would be the terms sewer vapor or sewer air, which some have chosen to substitute for it. It is proper here to add that the offensiveness of odors is no test of their insalubrity, but that the most fatal germs are often conveyed in an atmosphere which is odorless. The absence of unpleasant odors, therefore, furnishes no proof that the air does not contain sewer emanations.—*Popular Science Monthly.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Hamilton, O., will endeavor to procure the necessary legislation to give the city the power to issue bonds for water-works without having to wait until next spring for a "general election."

Bloomington, Ill., will probably be lighted by gas from a well recently discovered. A company with a capital of $100,000 has been formed to pipe the town.

STREETS, DRAINAGE, ETC.

An English company offer $1,000,000 for the privilege of draining Lake Leman in Switzerland, provided they can have the land thus laid bare. They propose to drain it into the River Rhone by means of a canal 20 miles long.

Drainage of New Jersey Resorts.—Long Branch, Nov. 1.—The Grand Jury has brought in presentments against the towns of Long Branch, Ocean Grove, Ocean Beach and Asbury Park, on account of the alleged imperfect drainage of those summer resorts, which is received with profound astonishment by the citizens of the localities named. To your reporter, Mayor James A. Bradley, of Asbury Park, stated that the action of the Grand Jury is regarded as a severe blow to the interests of the summer resorts all along the shore. Mayor Bradley said positively that no sewers are run into the lakes and rivers of Asbury Park or Ocean Grove. No sewers are run into Shark River, and besides the ocean's tide flows into that stream. The Common Councils of the four towns mentioned claim that they can prove that their respective corporations are properly drained, and think as a matter of justice they should be granted at the earliest possible moment an opportunity to refute the charges which the Grand Inquest has seen fit to bring into court. Two members of the Grand Jury are from Long Branch, and two others from Asbury Park. In addition to the above-named presentments, G. B. Sant, of the Octodon House; C. H. Dederer, of the Peninsula Hotel; M. Rosevelt, of the Casino; Road Master John N. Megill, the Rev. Miflin Paul, James H. Corey, of the Hotel Bellevue, and William H. Cooper, all at Seabright, were indicted "for allowing their drains to be discharged into the Shrewsbury River, creating the noxious, filthy, offensive and unhealthy substances and unwholesome matter complained of."

RIVERS AND HARBORS.

Cannot Build a Light-house.—Victoria, B. C., Nov. 7.—Nothing but disaster has attended the effort to construct an iron light-house at the mouth of Fraser River. After the experience of two seasons and the fruitless exertion to obtain a foundation for the structure, the attempt will be abandoned and the lightship re-established. The last report from the spot is that the stone dumped there and the cribbing are all washed away or covered by constantly shifting sand.

The Congressional Committee has started on its tour to find out what improvements are needed on the Mississippi River.

RAILROADS.

Color Blindness.—Copying the Pennsylvania Railroad Company, the Pittsburgh, Cincinnati & St. Louis management will, in a few days, commence the examination of train employés upon color-blindness and defective vision, and employés who fail to pass examination will be relieved.

A New Indiana Road.—A project is on foot to build a railroad from the coal fields in Parke County north to Clark's Hill, and to extend it further north in the future.

The Springfield & Southern Railway Company has filed articles of incorporation at Springfield, Ill. The road runs as follows: From a point in the city of Springfield, Ill., thence in a southerly direction to a point on the east bank of the Mississippi River in the county of Jackson, with a branch line commencing at a point upon said main line in the county of Montgomery or in the county of Madison, and from thence to a point in the city of East St. Louis in the county of St. Clair, Ill., the principal business office to be at Mattoon, reserving the privilege of changing said office to the city of Springfield. Capital stock $500,000, with privilege to increase to $3,000,000.

Capitalists have been given the privilege of building a street railway in Petersburg, Va.

The Canadian Pacific.—Winnipeg, Man., Nov. 17.—The Canadian Pacific Railway is now graded to Maple Creek, and work is being rapidly pushed toward South Saskatchewan. There will be heavy grading at the latter place on both sides of the river. Tracklayers are now twenty miles west of Swift River Current Creek. The bridge here is about 175 ft. in length. Work on the permanent bridge has not yet been commenced, and only a temporary bridge will be constructed over the South Saskatchewan River this season. The Southwestern Branch tracklaying has reached a point eighty-eight miles from Winnipeg.

Articles of incorporation are being drawn up for the Albion, Carmi & Shawneetown Railway Company. The road is to run from Olney, Ill., south to Shawneetown, a distance of eighty-five miles. The capital stock has been placed at $1,000,000, and the principal office located at Carmi.

The first sod of the Interoceanic Railroad was turned on the 1st inst. at Salina Cruz, Mexico, in the presence of the authorities of Tehuantepec and a numerous crowd. About 500 men then began to work.

Colorado Road.—The Boulder, Left Hand & Middle Park Railroad have begun grading in several places on their line.

A Page of History.—From papers now in the possession of certain of the Nickle-Plate officers, it appears that there is connected with the new road a history extending back over a quarter of a century. As early as 1857, the road-bed of a trunk line, with a route similar to that of the present Nickle-Plate, was built. This road was known as the American Central, and was projected by a son of Dewitt Clinton in 1853. The original plan contemplated a road to run from Hudson, O., to the state line of Pennsylvania. From the eastern terminus the line was to extend to the sea-board, and was known as the Clinton division, while a western division was called the Tiffin & Fort Wayne Railway. Work began almost simultaneously upon each of the three divisions of this American Central, and by the summer of 1857 more than 200 miles were graded, ready for the ties. The scheme was incorporated in Pennsylvania, Ohio, Indiana, and Illinois; but in the panic of 1857 the project went to pieces. Nothing more was done until about 1865, when Adam Smith projected a trunk line from the Atlantic to Omaha. Mr. Smith went to England to purchase rails, and was never heard from more. In 1870, Wm. Wood, of Jersey City, engaged an engineer, and re surveyed the whole route. The project failed to materialize, but additional rights of way had been secured and large subscriptions voted. In 1873, all these projects, contemplating the building of a trunk line over about the same route, failed, and only the graded road-bed, extending for miles, remained as a fitting monument of the people's losses. Among the heavy investors in the trans-continental schemes was W. H. Gibson, of Tiffin, O. He attended every sale of the right of way, and gradually acquired control of the strip of property extending 200 miles through the heart of Ohio, and wide enough for a double track railroad. This right of way, representing several million dollars, was offered to Vanderbilt, but he would not take the property. It was offered to Gould, but he had no use for it. Finally, Gibson saw George I. Seney, and a trade was struck for the purchase of this valuable right of way and road-bed for $100,000. W. H. Gibson obtained his $100,000, and he was the only person of the hundreds who sunk to the aggregate $5,000,000 that ever received any return for his investment.

Two New Pennsylvania Roads.—A charter was granted on the 9th to the Erie & Wyoming Valley Railroad Company, the line of which is 68 miles long, running from Port Griffith, Luzerne County, to Lackawaxen, Pike County, through Luzerne, Lackawanna, Wayne and Pike counties. The capital stock is $3,000,000, and the officers are: President, Edward W. Clymer, Reading; Directors, Samuel Hines, William A. Way, Charles E. Bradbury, E. W. Ives, Scranton; E. P. Darling, J. V. Darling, Wilkesbarre. A charter was also granted to the Pittsburgh & Whitehall Railroad Company, the line of which is to be seven miles long, all in Allegheny County; capital stock, $300,000. President, Oliver D. Phillips.

The Wheeling *Intelligencer* of the 29th ult. says:

"There seems to be no longer any doubt that the Baltimore & Ohio Railroad Company has purchased the narrow-gauge line between Pittsburgh and Washington, Pa., known as the Pittsburgh Southern, and that the purpose is to rebuild a portion of it and make the line a standard gauge road, and, as such, their route from Pittsburgh to the West, by way of this city. The same company is also pushing its rights of way along the line of the Hempfield extension between Washington, Pa., and the Monongahela River, and will probably let the line to contractors in a few weeks. It is understood here that the Vanderbilt line, known as the South Pennsylvania, which has been surveyed between Harrisburg, Pa., and this city, is nearly ready to be let to contractors. The River Railroad between this city and Parkersburg, projected under the auspices of Senator Camden, of this State, and a syndicate of capitalists, is surveyed and located and about ready to let. It is understood that the South Pennsylvania will cross the river here on a bridge, and connect with the Wheeling & Lake Erie road, now completed from Toledo to within fifty-eight miles west of this city. When the Hempfield extension is completed between this city and the Connellsville division of the Baltimore & Ohio, it will be their main line east from Chicago, and will materially shorten the distance and save one mountain grade."

The Mexican Central.—A recent official statement of the Mexican Central Company to the New York Stock Exchange declares that the main line of the Mexican Central road extends from the City of Mexico to Paso del Norte, 1,300 miles, where it connects with the Atchison, Topeka & Santa Fe, the Southern Pacific and the Texas & Pacific roads. The Western interoceanic branches will extend to San Blas on the Pacific Ocean, 430 miles, and the Eastern branch to Tampico on the Gulf of Mexico, 318 miles. Five hundred and twenty-two miles of road have been completed, of which 483 miles are on the main line. The progress of construction justifies expectations of completing the road early in 1884.

BRIDGES.

A new bridge company has been formed in East Saginaw, Mich., to bridge the Cass River. Capital stock, $10,000.

A Colorado Bridge Finished.—The Greeley, Salt Lake & Pacific (N. P.) Railroad have completed the bridge in Boulder Cañon and have began to lay steel.

BUILDING.

A new hotel is being built at Manistique, Mich.

The new Court-house at Mason City, Iowa, is rapidly nearing completion.

The Washington monument is now 392 feet high.

LABOR.

Laborers in Montreal are getting from $1.50 to $1.75 per day, and the demand at these figures is greater than the supply.

TUNNELS.

The tunnel on the New York, West Shore & Buffalo Railway, at Weehawken, was pierced on the 8th inst., and the entire length of 4,000 feet can now be walked through. It is now 20 months since commencement of work. It will be entirely completed next month. A full description of this work appeared in Engineering News of June 17, 1882.

CONTRACTS LET.

A Railroad Contract Let.—A despatch from Columbus, O., dated Nov. 2, says: The Redfield syndicate to-night signed the contracts with Stearns, Norris & Co., for building the Columbus & Eastern Railway east from this city for sixty miles to the Moxahala coal fields, the road to be ready for cars Aug. 1, 1883.

A Florida Contract Let.—The contract for the work on the Apalachicola Harbor has been awarded to Mr. John McGuire, the lowest bidder, and operations will soon begin.

A Florida Water-works Contract Let.—The Sanford water-works will be completed in ninety days. The contract for the construction of the same has been awarded to Messrs. Ferrell & Muckle, of Philadelphia.

Building Contract Let.—Thos. W. Boyd, of Pittsburgh, has been given the contract to build the new Lexington (Ky.) Court-house, and his plans accepted. The contract price is $91,000, and the building will be of stone.

A contract has been let for building a new jail at Camden, N. J.

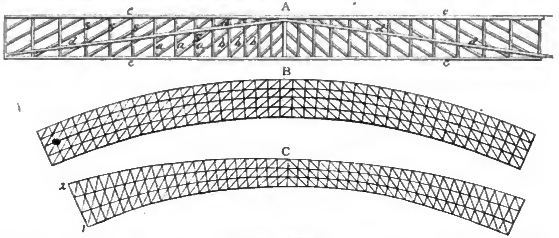
TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

Hermann Haupt, of Pennsylvania, filed, Dec. 27, 1839, papers of protection in the Patent Office for the term of fourteen years.

Haupt has a grievance. He says that "theory, observation, and experiment all agree in the conclusion that one-half of the inclined pieces are of no use as counter braces, and badly answer the purpose of ties." He instances some bridges on railroads in Pennsylvania, in which the lower ends of the counter braces were all split while the main braces were intact.

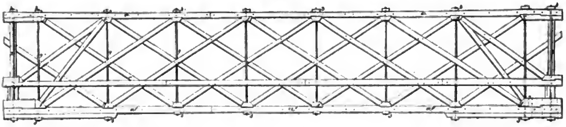


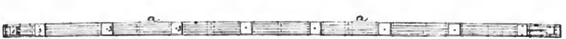
HAUPT'S BRIDGE.

His proposed improvement is represented by the diagram marked *A*. Instead of counter braces, vertical ties are used whereby the weight instead of exerting a cross strain, as in the ordinary lattice, is made to act in a direction parallel to the fibres of the tie.

The truss consists simply of the chords *c*, the braces *b*, and the ties *a*, framed precisely as a lattice truss. In this plan the depth of the arch is necessarily small.

FIG. 1.





HOWE'S BRIDGE.—FIG. 2.

The trusses *B* and *C* consist of a series of curved chords, which vary in size according to pressures, and connected with braces and ties in precisely the same manner as has been explained in connection with the truss *A*. In fact, if the truss *A* be supposed bent into a curved form it will become similar to truss *B*, and *C* differs from it only in the chords not being concentric.

William Howe devised an improvement in truss bridges, the patent for which was granted July 10, 1840. This patent is mainly embodied in a succeeding one which was granted him the following month; and for that reason is not deemed of sufficient importance to be given, beyond a passing mention.

The second patent issued to Howe was dated Aug. 3, 1840, and was re-issued Sept. 3, 1850. The truss frame is, in many respects, like the preceding patent, but it differs therefrom in that the tightening of the bridge is effected by iron rods having screw nuts, and of wedge pieces so placed as to be effective by the action of said screw rods.

Fig. 1 is a side view of the truss, which has rods of iron in the place of the posts for the "straining up," above referred to. Fig. 2 is a top plan view of the truss. 1 1 1 are wedge pieces of hard wood or of iron, which are placed crosswise of the string pieces or chords *a a a a*, to form the bearings of the braces and counter braces. Pieces of wood or of iron, 2 2, are also placed at the ends of the truss frames, having their ends bearing against the string pieces for the purpose of counteracting the action of the turning screws. 3 3 are blocks of wood or iron placed between the screw nuts and the chords for the iron bolts or posts to pass through and form an equal bearing on the chords, both above and below the truss frame. 4 4 4 are the iron bolts which are to be "strained up" by screw nuts, which have their bearing against the pieces 3, or against washers placed upon them.

To cause the truss frame to "camber" by the tightening of the screws, it must be so framed in the first instance as that, by the length of the braces inclined toward the center, or by the width given to the upper wedge pieces 1 1, it will camber to a certain extent, which effect will then necessarily be augmented by the tightening of the screws.

(TO BE CONTINUED.)

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* Copyright, 1882.

TRUSS-BRIDGES.*

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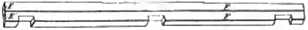
By F. B. Brock, Patent Attorney, Washington, D. C.

Price and Phillips, by Letters Patent, bearing date Feb. 23, 1841, constructed a bridge which they styled a "Puzzle Keyed Bridge," from the fact of its being similar in its joining to the binding together of the toy, sometimes called a "puzzle knot." The improvement consists in the employment of the last pieces of timber inserted in the truss frame in such a way as to cause them to operate as keys, and to bind the whole frame together without the use of trenails, bolts, wedges, etc.

FIG. 5.



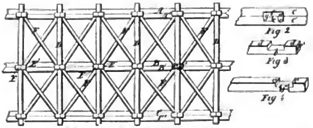
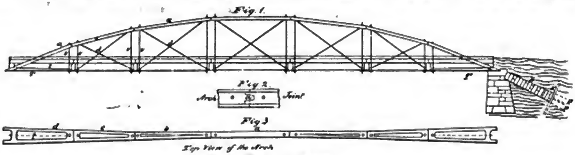


FIG. 1 PRICE & PHILLIPS' BRIDGE.

Fig. 1 is a view of a part of a truss frame, and Figs. 2, 3, 4, and 5 details of the same. *A A* are two upper chords, *B B* two similar chords which sustain the floor timbers and *C, C* the lower string pieces or chords; *D D* are vertical posts which are double like the chords, and embrace the chords between them; *E E* are the ends of the cross-ties embraced between the string pieces, and forming also the keys by which the trusses are bound together; *F F* are the ordinary cross braces.

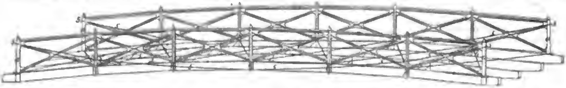


WHIPPLE'S BRIDGE.

Fig. 2 shows one of the combined chords *C C*, with a front view of the notches which are to admit the cross-ties. The first cross-tie occupies the end *a*, and it is to be notched out as shown in Fig. 3. The edge *b* is placed so as to occupy the recess *c* in the chord C^2, and so that the face *d d* of the cross-tie may be in range with the dotted line *f*. The piece *C* of the lower chord serves to retain the first cross-tie in place. The length of the notch in Fig. 3 is equal to the width of the double upright posts. These posts are to be notched out at each joining of them, with the respective chords and the cross-ties, in the manner shown in Fig. 4, the chords being embraced between the ends of the notch *oc*; and the notch *f* in each of the posts coinciding with the opening *g*, which is to receive the second cross-tie by which the whole is keyed together. The second cross-ties may be made somewhat wedge-formed, as shown at *E*, Fig. 5, where a pair of cross-ties are represented. When inserted, the effect is to strain up the first string piece, and truss the whole of the frame work together. The inventors say their invention can be applied to arch bridges.

April 24, 1841, Squire Whipple, of New York, received a patent for an iron truss-bridge, which possesses some features in use in the bridges of to-day. This patent was extended seven years from April 24, 1855. The construction embodies two or more trusses of iron. Each truss consists of an arch *a* of cast iron, extending the whole length of the span. One or more trust-ties *T T* extend along or through or near to the chord of the arch, and connected with the extremities thereof. To sustain the thrust and prevent the spreading of the arch vertical rods *v v* of wrought iron are used, which serve both as ties and posts between the arch above and the floor and thrust-ties below. Diagonal ties *d d* of wrought iron or braces of cast iron, in pairs, cross one another between the vertical rods and between the arch and the thrust ties *t*, except under the segments of the arch where only one tie is used. The arch is formed in segments of from 10 to 20 ft., and is made of angle iron, the flanges depending. The arch is narrowest in the middle and diverges toward either end, which counteracts lateral flexure. The joints of the arch are furnished with extensions and depressions, as seen in Fig. 2. To give the diagonal ties a more uniform obliquity, the segments may be made shorter towards the ends of the arch. One thrust tie is under each side of the arch. The abutments may be strengthened by a slope wall *s*, or frame work of timber on the back side extending into the earth so as to form nearly a continuation of the arch of the truss.

July 10, 1841, Earl Trumbull, of New York, invented an improved mode of constructing bridges. The engraving represents an isometrical perspective of the trusses, each composed of wrought-iron tie rods and suspension rods extending from end to end. The sills extend from a post in one truss to the opposite post in the other truss. The cross braces are of wrought iron and serve to strengthen the roadway and prevent any lateral motion of the bridge. What the inventor terms suspension rods are represented by the Figs. 5 5, etc. They are of wrought iron, and spring from a point near the top of the end posts *a a*. It will be



TRUMBULL'S BRIDGE.

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* Copyright, 1882.

observed that these rods form a suspension curve. These rods pass at the apex under the center sill, and support the truss at the points either by passing under projections cast for the purpose to the posts or by passing through holes in projections on the sills. The suspension rods are placed on both sides of the truss. The tie rods extend the whole length of the bridge, passing over the projections at the ends of the sills, being confined to their places at these points by small notches cast to receive them.

(TO BE CONTINUED.)

THE VIADUCT OF THE VAL SAINT LÉGER, ON THE PARIS BELT RAILWAY.

[Translated from *L'Illustration*.]

The magnificent viaduct of the Val Saint Léger, near Saint Germain, on the great circular railroad of Paris, near Mariel Marly, must be considered as one of the finest specimens of engineering art.

There were considerable difficulties in the way of construction, owing to the loose nature of the soil on which it is built, still, despite these and the importance of the work in itself, the cost did not exceed 1,251,000 francs.

The viaduct has certain peculiarities of construction that will be interesting to our readers, and an explanation of which will redound to the credit of the two eminent engineers who constructed it, M. Armand, head engineer, director of the railway in question, and who has directed some 700 kilometers of railways, and especially the Algerian network of roads, and M. Ch. Geoffroy. Besides these must be mentioned M. Berton, sub-engineer, M. Regnier, and the contractors, Messrs. Hersent & Roussel.

The viaduct is built over a valley in which the geological conditions were most unfavorable, and the engineers were delayed a long time in making the survey for the line. Several places were selected and had to be again abandoned, and it was only after careful study that the solution now carried into execution was adopted.

The numerous soundings made showed that the sides of the valley were formed of calcareous banks, more or less disjointed and resting on a deep layer of clayey and very watery sands, below which was a thick bank of plastic clay. This last rested on the chalk, which may be observed cropping up at Marly, and which is only met with where the viaduct is built at a depth of from 25 to 32 meters.

As the calcareous strata did not exist in the lower part of the valley the foundations had to be laid on this chalk, and for the first time at such a depth.

The various systems of laying foundations, such as timbered shafts, piles, etc., were examined and laid aside, as was also a plan with metallic arch which would have looked very fine, but which could not be considered as sufficiently solid, owing to the slips of the calcareous layers which would certainly take place. It was then decided to have a straight-beam metallic viaduct of a total length of 311 meters (337 yards), so as to rest the abutments supporting the ends of the iron framing on the calcareous sides of the summits and sides of the valleys and of the thalweg. Wherever these banks were much inclined, disconnected or altogether absent, it was necessary to support the frame work by three piles which were sunk to the chalk by iron caissons, such as are used in pneumatic foundations. The work was then composed of two abutments in masonry of a length of 53 meters, formed of arches of 8 meters span and a metallic part 258 meters in length, supported by three piles and divided into four bays, those in the middle being 70 meters and the two near the abutments only 56 meters.

The apparent portions of the masonry is in tufa, which, from its red tint, contrasts well with the corners and copings, which are in white cut stone.

The metal part proper is formed of four large beams placed under each of the rails of the line. These beams are connected by girders of great lightness and with a platform in corbelling. The frame-work weighs only 5,000 kilos per linear meter, although for such heights this limit is often exceeded.

The middle pile has only an apparent height of 20 meters, but it measures 45 meters from the foundation. The frame-work required only 10 men to make it advance in sections of 100 meters over the rollers, and at a rate of 30 meters 60 cent. per hour.

ENGINEERS AND ENGINEERING IN FOREIGN LANDS.

The future of engineering projects promises well, as there is hardly any other field left for the absorption of capital. The French, Belgian and German iron markets are firm, and the new St. Gotthard line opening up the Italian markets for German coal.

Among the latest things in the way of canals is a plan to unite Cologne and Antwerp. The Chamber of Commerce of the former city has taken up the question enthusiastically, and there is no doubt of the support of the Prussian Government.

The next working campaign on the Panama Canal will open in December, and great preparations are making to have it as productive as possible. The Culebra mass is to be soon attacked, and preliminary surveys have already been made on the Atlantic side, at Lower Obispo, at Emperador, and at the culminating point where the Culebra shops have been put up. Working stations will also be opened at Gorgona, and at Paraiso, on the Pacific slope. To the greater facility of taking away the rubbish, a railroad will be built between Chagres and Emperador. Of the material ordered, including 28 excavators, only four are yet in use, and 22 locomotives are shortly expected to arrive. The dredging material comprises four dredging engines, with spout of 60 horse-power, but only one is yet in use. Steam derricks, etc., are being sent, and altogether matters are taking a business look.

Most newspaper readers will recollect the catastrophe that the City of Szegedin—the second city in Hungary—met with a few years ago (1879), when, owing to the overpowering rise of the Theiss, the greater part of the city and many lives were destroyed. It was even said that only three ducks could be seen in the environs immediately afterward. As freshets are as dangerous here as they were in Szegedin a few years ago, and as they have lately been in Verona, of Romeo and Juliet fame, it is of interest to see that in the case of the former city, various methods have been resorted to for future protection. A commission composed of engineers and specialists was designated, and the works already executed, or in course of construction comprise what may be called a series, viz:

The building of quays and enrockments.

The canalization of the city.

Elevation of the city level.

Regulation of the course of the river, and finally the building of a bridge, etc. The cost of the quays is estimated at 1,500,000 florins. But, despite the elaborate system of double quay with enrockment, the engineers came to the conclusion that the best method for protecting the city against inundations was to rise the general level. This was only 3.07 meters above zero, while the waters of the Theiss have reached as high as 8.52 meters. Embankments were therefore made to 8.50 meters for the interior boulevards, while the avenues, which in this case are radial will have a uniform slope of from 8.50 meters to 6.70 meters between the two boulevards (circular roads). Trains were used for the purpose of embanking and rapid progress was made—fifty trains being run per diem. The greatest height of the embankment was 3 meters, and some one million cubic meter of earth will be required. The system of dikes on the right bank, with circular dike round the city, will be completed by a plantation of 40 hectares and by an extensive enrockment. The dikes on the left bank will necessitate a displacement of 5,000,000 cubic meters, and the talus on the water side will be furnished for a distance of three kilometers with a brick facing. Several sinuosities of the water course will also be cut. Numerous other works of great importance are under consideration—such as the regulation of the Danube between Vienna and the Hungarian frontier, and a canal from the Danube to the Oder.

Elevated railways would seem to offer a greater field to contractors and engineers than was at first supposed. The elevated roads have been roundly abused, and certainly they are not to be compared to those on *terra firma*; but the case is otherwise when we have to do with subterranean. However highly the Metropolitan, of London, may be extolled, it should be borne in mind that there is usually very little difference in London between the gloom below and the fog and gloom above. But the Parisians, when a project of an underground railway was broached, did not take kindly to it, and preferred to travel suspension fashion than "down among the dead men." So plans for the elevated style are still being offered, and now and then accepted by large cities where space is so valuable. An English engineer, Mr. Fogerty, has just carried off the concession for an elevated road, although among his competitors were Baron Schwarz and Engineer Bode, both having plans for an underground line.

WORK OF THE ENGINEER CORPS.

ANNUAL REPORT OF GEN. WRIGHT, CHIEF OF ENGINEERS.

WASHINGTON, Nov. 14.—Gen. Wright, Chief of Engineers, in his annual report makes an estimate of $55,000 for engineering, maintenance, repairs, and construction of the Washington Acqueduct. The estimates for the care of public buildings and grounds in the District of Columbia amount to $232,000. General Wright says that an appropriation of $150,000 should be made for examination and surveys and contingencies for river and harbor improvements, for which there is no special appropriation, of which sum $50,000 should be for surveys, $100,000 for contingencies, including incidental repairs of harbors. The preparation of the final report on surveys of Northern and Northwestern lakes has been completed, and it is now nearly half printed. Water level observations have been continued. The amount available for these surveys for the fiscal year 1882-3 is $12,000. The amount, required for the fiscal year 1883-4 for printing and issuing charts for the use of navigators is $8,000. The compilation of the new outline map of the territory of the United States west of Mississippi, scale 1-2,000,000 has been completed, and the compilation of a new outline map of the United States, on a scale of 1-5,000,000, has been begun and some progress made. Referring to the geographical surveys west of the one hundredth meridian, Gen. Wright reports that no field-work was done during the year, as there were no funds available for that purpose, and that the duties of the office have been confined to the reduction and computations necessary for putting unfinished map material in shape for publication and to the distribution of published maps and reports. He says that the amount originally appropriated for closing the work will not allow the publication of sufficiently large editions of the unissued map, nor furnish reissues of those maps now out of print and which have undergone revision. An estimate of $5,000 is made to cover the expense of such publication. The following surveys have been accomplished: Target range. Presidio of San Francisco, Cal.; reservation, Fort Halleck, Nav.; locating Presidio observatory rifle range at Angel Island, Cal.; rifle range at Fort Point, Cal.; water supply at Angel Island, Cal.; time determinators, with transit, at Presidio of San Francisco, and telegraphic signal exchange for determining longitude of Colfax, Washington Territory, have been accomplished. The estimate for the amount required for military surveys, reconnoissances and surveys of military reservations by the engineer officers, attached to the various head-quarters of military divisions and departments is $50,000, being an average of $5,000 for each of the nine military divisions and departments west of the Mississippi, and $5,000 for publication of maps.

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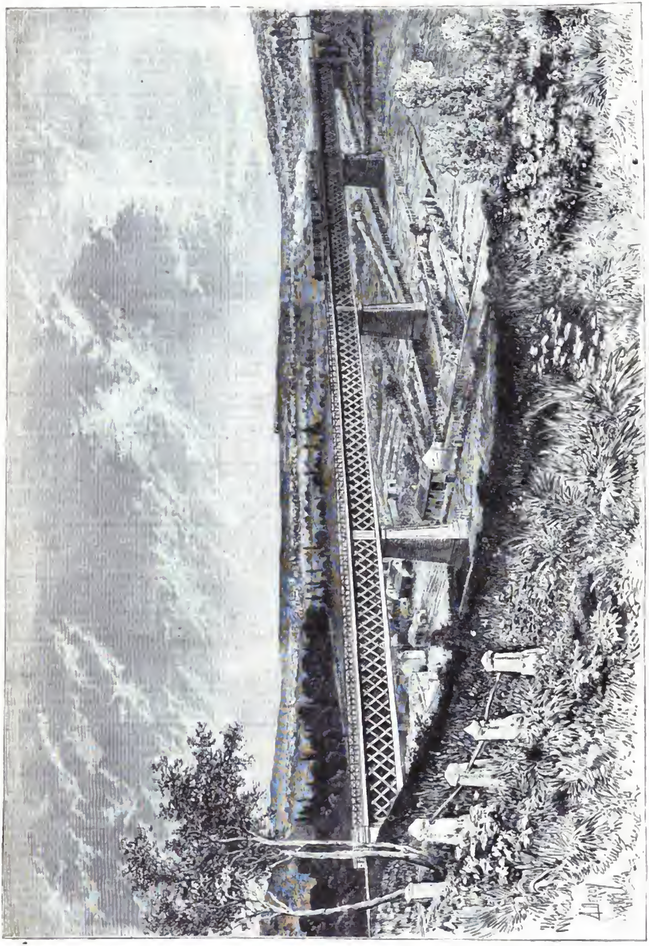
NEW ELECTRIC COMPANY.—Articles of incorporation have been filed with the County Clerk, this County, of the Faure Electric Storage and Light Company. Capital, $2,000,000.



THE VIADUCT OF THE VAL SAINT LÉGER, ON THE PARIS BELT RAILWAY.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR...............ASSOCIATE EDITOR.

SATURDAY, NOVEMBER 18, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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"SOME BIG THINGS."—In our last issue we published an article clipped from the New York *Sun* under the heading, "Some Big Things," which contained a brief description of the Kinzua viaduct on the Erie railroad extension, and gave the name of the Keystone Bridge Company as builders. The bridge in question was built by Clarke, Reeves & Co., Phoenixville Bridge Works, Phoenixville, Pa. We regret the error, especially as the bridge has attracted much attention, and as we always believe in rightly accrediting the successful accomplishing of a difficult work.

SUBSCALES INCLUDING VERNIERS is the title of a little pamphlet by Henry H. Ludlow, U. S. A., which presents a more thorough discussion of verniers than those in the ordinary text-books and in a very methodical and scientific manner. The word subscale refers to any auxiliary scale of equal parts, of which the vernier is a special case. A complex subscale is illustrated which will enable one to measure hundredths of an inch on a common rule divided to quarter inches. It is shown that in all measurements for the accurate measurement of angles, no form of subscale can surpass the vernier.

WHEN "The History and Statistics of American Water-Works" is published as a book of some 1,000 pages next year, we suppose that the officers of the water-works of Reading, Pa., Wheeling, W. Va., Mobile, Ala., Davenport, Ia., San Antonio, Tex., and Springfield, Ill., will feel deeply aggrieved and indignant that they alone of the 100 largest cities in the United States should be omitted and their works not described. But if that should be the case they will have themselves only to thank for the omission. Mr. Croes has written to each of them four or more times, begging them to send the data of their works and enclosing blanks. Not a reply has been received, and without the information, of course no description can be prepared.

STRESS AND STRAIN.

In exact science it is necessary to have a great number of technical or special terms, which are always to be used in accordance with prescribed definitions. The boy finds in the first pages of his geometry long explanations or definitions attached to simple words like line, plane and circle, or rather he finds that these words have been selected to represent certain precise ideas. Previously he used the word plane with more or less vagueness; now he uses it with a clear idea of how it may be distinguished from other surfaces. So also with such a term as center-of-gravity. When employed in popular language its meaning is usually something like middle point; when technically defined the problem is half solved how to find and locate it.

When the words stress and strain are used in common language their meaning is more or less clear to everyone. Strain is a force exerted between bodies or parts of bodies. If two men pull a rope they strain it and the more they pull the more it is said to be strained. Straining is not the same as stretching, for the same term would be used for a wire or rod where the stretch would not be apparent under ordinary pulls. If a weight rests on a post the post is strained. The word stress seems to be commonly used when used at all, with the same meaning as strain. But it cannot be said that the rope or the post is stressed, for the word stress, although once used as a verb, now has a very awkward look and sound. For the ordinary purposes of ordinary language strain is employed to denote an idea tolerably clear to those who use and hear it.

But when forces are studied with exactness care must be taken in the use of language. So stress and strain must be defined. Some writers, at the head of whom we may put Rankine, define stress as a force exerted between two bodies or parts of bodies, of the nature of a pull, push, bend or twist. And strain they define to be the change of shape or deformation produced by the said stress. Thus when a weight is hung on a rope it is stressed and strained; the stress is the weight and the strain is the amount of its elongation. If a load be put on a beam the load is called the stress and its bend or deflection the strain. Now it is proper and necessary that technical terms should be selected to designate these two distinct ideas, but the choice of strain to denote the stretch or change of shape seems very unfortunate on account of its conflict with the common use of the word. And in general engineers have refused to accept the definition of these writers, and have continued to use strain to denote forces measured in pounds or kilograms. No American engineer, at least, would think of saying that a bar of wrought iron *stressed* up to its breaking point ought to *strain* twelve per cent. he would certainly say that if *strained* to rupture it should *elongate* that per cent. Stress is a good word as far as it goes, but it is a word found mostly in the books, and is not often seen in engineering periodicals or often heard at the engineering conventions.

Other authors, at the head of whom we may perhaps put Stoney, define strain as force acting upon a body tending to produce change of shape. They also use the word as referring to the internal forces or resistances. If a weight be hung on a rope the weight is the strain and in all the fibres strain is produced. Stress they rarely employ, or use synonomously with strain. For the elongation or bending of the body the term deformation is employed. This method possesses the advantage of agreeing closely with common usage, and the disadvantage of using the word strain with two quite distinct meanings.

A third plan is to use the word stress for the force acting on the body, strain for the internal molecular force thus produced, and deformation as a general term for change of shape. This would seem to preserve the advantage and avoid the objections to both the other methods. The weight on the rope is a stress and in all the fibres there are resisting strains. Thus a strain is produced by a stress. A stress is an external force, a strain an internal force. When the load is placed on the post it compresses it or brings its molecules nearer together, and immediately is generated a force to resist and prevent it. The nearer together the molecules are forced by the stress the stronger becomes the repelling strain. On a beam the exterior stresses produce internal shearing and longitudinal strains. By this plan the common meanings of the two words are not distorted and distinctness is given to two really separate things.

It is an old saying that a problem throughly understood is half solved. The proper selection and consistent use of technical terms in applied mechanics undoubtedly is of great assistance in imparting clear ideas of the relation of forces in the questions investigated. Let it be understood that stresses and strains are both forces, the former known and the latter unknown, but connected with each other by the fundamental conditions of static equilibrium, and the problems of the engineer become at once clearer and hence more easily investigated.

PERSONAL.

CAPT. JAS. B. EADS and MRS. EADS returned from Europe by the Alaska on the 12th.

J. VINCENT BROWNE, formerly Contractor Chief Engineer on the Quebec Harbor Improvements, and for the past year engineer for the contractors, Beemer & Sullivan, on the Welland aqueduct, has resigned his position, and will devote his time in carrying on the contract (which was awarded to Lim and Mr. H. Griffiths) of rip rapping the banks of the Welland Canal on the summit level, a distance of about fourteen miles. The contract amounts to some $120,000. We wish Mr. Browne every success in his new work, and if we are to judge from his career of the past nine years in Canada as an engineer, success will surely attend him in his new sphere as a contractor.

NEW PUBLICATIONS.

GATE VALVES AND FIRE HYDRANTS is the title of a "handbook," compiled by A. H. Howland, C. E., and published by the Chapman Valve Manufacturing Co., for advertising purposes. It is a well-bound octavo volume of 176 pages of reading matter, besides many pages of ruled blank-note paper, for memoranda. Very naturally it tells all that can be said about valves and hydrants, information that is of great value to all parties using such articles, and also to the general public. But in addition to this purely business aspect of the book, there are some valuable essays on important subjects, and over one hundred pages are devoted to carefully selected tables and memoranda, taken from standard technical "Pocket Books," such as Trautwine's, Hamilton's and Ellis', the whole forming a most useful treatise, which must commend itself to water-works officials. All correspondence respecting the book must be addressed to the Chapman Valve Manufacturing Co., at Indian Orchard, Mass.

HARBORS AND ESTUARIES ON SANDY COASTS. By L. F. Vernon-Harcourt, M. A., Member of the Institution of Civil Engineers, London.

We have received from the author a copy of his paper on this interesting subject, in the shape of an extract from the minutes of the proceedings of the institution, April 25, 1882. The paper fills more than thirty octavo pages, and is illustrated by three large plates, each containing ten or more figures, and showing the plans and details of ten or twelve harbors, with a map of the French and Belgian coasts from Calais to Ymuiden.

The author alludes in the outset to the main cause of the formation of the numerous sand-banks along the shores of the North Sea, near the Straits of Dover, and the effects which have followed interference with the normal flow of the inshore currents. He then gives a succinct description of each of the harbors of Calais, Gravelines, Dunkirk, Nieuport and Ostend, with an account of the successive steps which have brought them to their present conditions; the effects produced by the various works of the engineer and their motives. All these are jetty-harbors and present a remarkable similarity both in their early history and in the methods adopted for their improvement and maintenance.

The author next makes a comparison between jetty harbors and others. He refers to the interesting example of the conversion of a jetty-harbor into a large closed harbor, now being carried out at Boulogne, where an extensive area is to be inclosed by massive stone breakwaters, through which two openings are to be left of about 500 and 800 ft. respectively.

A description follows of Madras harbor, which is cited as an instance of a harbor situated on a sandy coast and inclosed by solid piers. Its general shape does not differ much from that of Boulogne, except there is but one entrance at Madras. This entrance is situated in a depth of water of 45 ft., while at Boulogne the depth at the entrances will not exceed 26 ft. The range of the tide at Madras is only 3 ft., while at Boulogne it is nearly ten times as great.

The author concludes his consideration of this topic with the statement that, "if Boulogne and Madras harbors, and other similar harbors recently constructed, fulfill the expectations formed of them, they will afford valuable evidence of the conditions under which closed harbors on sandy coasts can be maintained without difficulty, of which Kingstown harbor furnished formerly the only satisfactory example. The danger to these harbors, as well as to jetty-harbors, consists in the progression of the foreshore, as tidal scour and dredging are capable of coping with the accumulations inside."

The subject of estuaries is next taken up and illustrations of the author's views are given from the mouth of the Adour, the Seine, the Maas, the Mersey, the Scheldt, the Tyne.

The "discussion" which follows is very interesting, having been participated in by many engineers of distinction, such as Brown, Thorowgood, Hawkshaw, Redman, Hutton, Coode and others. The same may be said of the "correspondence," the names of some of the contributors being those of experts of several nationalities beside the English. On the whole, this volume of more than one hundred pages may be deemed a most instructive addition to the literature of the day on the very important subjects of which it treats.

The same author has also recently published a treatise on rivers and canals, relating to the control and improvement of rivers, and to the design, construction and development of canals. This appears as an octavo volume of 350 pages with another volume containing 21 large plates.

CORRESPONDENCE.

PRESSURE OF EARTH ON BURIED STRUCTURES.

NEW YORK, Nov. 16, 1882.

EDITOR ENGINEERING NEWS:

Will you or some of your readers throw some light on the subject of pressures of earth on buried structures, for instance, culverts, or inform me where I shall look for such light, and oblige,

A SUBSCRIBER.

BROCK'S BRIDGE TRUSSES.—CORRECTION.

340 SOUTH TWENTY-FIRST STREET,
PHILADELPHIA, Nov. 16, 1882.

EDITOR ENGINEERING NEWS:

In the letter of mine that you printed in ENGINEERING NEWS last week, the words "low strung" (last line), should have been "bow string."

Respectfully yours, THOS. M. CLEEMANN.

IRON BRIDGE COMPLETED.

THE CLARKE BRIDGE CO.,
No. 7 SOUTH STREET,
BALTIMORE, Nov. 16, 1822.

EDITOR ENGINEERING NEWS:

We have just completed a large iron bridge over the Savannah River for the Charleston & Savannah Railroad. There are six fixed spans of 144 ft. and a draw span of 196 ft., making a total length of 1,060 ft. We have other large contracts on hand.

Yours very truly,
THE CLARKE BRIDGE CO.

FLINT'S SURVEYING.

CITY SURVEYOR'S OFFICE,
PATERSON, N. J., Nov. 6, 1882.

EDITOR ENGINEERING NEWS:

After reading your article on "Early American Books on Surveying," in your issue of Nov. 4, I referred to my edition of "Flint on Surveying," and found that it was printed at Hartford in 1858, or six years later than you supposed the last edition was printed. We consider it ona of the best text books in our office, and is put in the hands of all our new assistants in preference to any other work. The work is scarce, but it would bear reprinting.

Respectfully yours,
JOHN T. HILTON, City Surveyor.

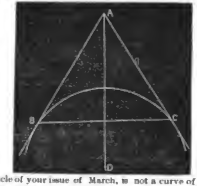
SPIRAL CURVES.

S. P. R. R., NEW GERMANTOWN, PA.

EDITOR ENGINEERING NEWS.

DEAR SIR: A curve of the second degree cannot be laid out between points *B* and *C* without it being symmetrical to axis *AD*, *BAC* being an isosceles triangle, and line *AD* bisecting angle *BAC*.

But as the spiral curva, damonstrated in tha article of your issue of March, is not a curve of the second degree, but of a higher degree, it can be run in, and not fulfill such conditions.



An experiment can be tried with a spring or any elastic substance.

Finally, the best proof of the statements in the enunciation of the spiral curva is that it should be laid out in the field, as directed in the article, when it will be found to be a practical success.

W. H. FRY.

THE ST. ANNE'S RIVER BRIDGE.

TORONTO, Canada, Nov. 13, 1882.

EDITOR ENGINEERING NEWS:

The contract for the bridge superstructure over St. Anne's River, on the Quebec & Lake St. John Railway, P. Q., was closed by the Board on the 7th inst., with the Toronto Bridge Company, represented by Job Abbott, President and Engineer. The clear span is 221 ft., and the bridge will be built with steel upper chords, posts, floor beams and stringers; the tension members being of Nova Scotia iron, manufactured at Londonderry, N. S. As you have heretofore credited this work to Clarke, Reeves & Co., Philadelphia, kindly insert above and oblige.

Yours truly. JOB ABBOTT.

WHICH IS IT?

BACKWOODS, Canada, Nov. 9th, 1882.

EDITOR ENGINEERING NEWS:

In last week's issue J.E. Castbergh, draughtsman, asks, "Engineers what is your opinion," on a portion of Mr. Trautwine's book.

As the book is in its "sixteenth thousand," I think there can be no two opinions as to its merits. I have read the portion alluded to and never thought it either a "mathematical failure or practical absurdity." Truly, one either must be hypercritical or else desirious of a little cheap notoriety, to make so "much ado about 'nothing or O.'" Engineers, what *are your opinions* on this?

Respectfully yours, S. L. P.

WHICH IS IT?

WASHINGTON, D. C., Nov. 8th, 1882.

EDITOR ENGINEERING NEWS:

In response to Mr. J. E. Castberg's inquiries in No. 44 of ENGINEERING NEWS, I would like to answer that Mr. Trautwine is correct as regards "shorten it to zero" as a comparison with any text book on mechanics will show. Yet I offer the following practical illustration of the "theoretical" action of a weight equal to the modulus of elasticity.

As he may be well aware the modulus of elasticity is that figure which tells us the change a body (a bar) of one square inch (unit) section undergoes in length under the stress of one pound (unit) of weight.

Take for instance a "*wrought*" iron bar 1 ft. long, one square inch cross section suspending 1 lb. As the modulus of elasticity for tension is say 27,000,000 lbs. it means that the above bar is extended or lengthened $\frac{1}{27000000}$ of a foot (of its length) under the given conditions; therefore it is evident that if I would suspend 27,000,000 lbs. from that bar it would be extended *one* foot. Its total length would now be two feet or twice its original length.

Likewise in case of compression, (modulus of elasticity being the same as for tension), if a weight of *one* lb. is pressing on the above bar it will be compressed $\frac{1}{27000000}$ of a foot. If then a load of 27,000,000 lbs. is put on, it would evidently compress the bar 1 ft. or in other words would reduce it to nothing or zero.

But it is evident that in neither case such is possible; it is merely a theoretical deduction; moreover under the assumption that in either case and under that excessive load, the bar would not alter its cross section nor be destroyed.

Your inquirer is therefore wrong in calling "and shorten it to zero or 0", "a mathematical failure" it is not a mathematical but *practical* failure and physical impossibility.

Hoping that the above explanation is satisfactory to him as regards the point in question, I remain Respectfully,

E. SCHMITT.

EARLY LOCOMOTIVES.

NEW YORK, Nov. 15, 1882.

EDITOR ENGINEERING NEWS:

The statement in your last issue that Mr. Toucey has been succeeded as Superintendent of the New York Central R. R. is incorrect, as he informed me to-day, in his office. He has, however, appointed Mr. Franklin as Depot Master.

I am reminded in this connection of the first experiments made with coal-burning locomotives on the New Haven R. R. by Wm. E. Worthen, Esq., who was then, 1853, Vice-President and Engineer.

Mr. Whistler, as superintendent, brought from the Baltimore & Ohio R. R. two of their camel back freight engines for trial on the New Haven road, and it was my pleasing and instructive duty to ride on the night freight train (Jo Franklin, conductor) from New York to New Haven and return to gauge the water in the tank at each station and weigh the coal (Cumberland) used on each round trip.

These clumsy machines carried terror along their course. The exhaust scattered live coals far and near, to the great danger of fences, bridges and buildings, as well as clothing, and although the tests showed superior traction power, they were soon laid by, supplanted by more modern coal burners.

JOHN AVERY.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 387.)

CCCCVII.—ST. JOSEPH, MO.

St. Joseph, Missouri, in lat. 39° 45′ N. long. 94° 53′ W., is on the Missouri River. The bluff at this point recedes about 5 miles from the river bank, and the city is on the "bottom" lands. It was settled in 1843 by Joseph Robidoux, and incorporated as a city in 1850.

Water-works were built by a private company in 1880, after plans and under superintendence of John W. Rutherford, C. E., taking the supply from the Missouri River, at a point 3 miles from the city, across a neck of land but 10 miles above the city by the course of the river. Two Worthington duplex steam pumps, each of 3,000,000 gallons capacity lift the water 320 ft. through 1,196 ft. of 16 in. cast-iron pipe into a reservoir in excavation and embankment with the inside slopes lined with one course of brick on edge, on 18 in. of puddle. After 48 hours subsidence, it is drawn into another reservoir whence it is distributed. The effluent main to the city, 2½ miles, is 20 in. and there are 24

Google

miles of cast-iron distribution pipe of 20 to 4 in. diameter, with 212 fire hydrants, 182 gates and 533 taps. There are 27 meters in use. The city pays annually $100 for each of 160 fire hydrants and $80 for each above that number. Service pipes are of lead.

The population in 1880 was 32,484. The daily consumption in 1882 is 2,500,000 gallons.

The capital stock of the company is $400,000. The works have cost $850,000. The bonded debt is $400,000, at 6 per cent. The expenses and receipts are not furnished for publication.

T. J. Clew, Jr., is Secretary, and Theo. W. Davis the Superintendent.

CCCCVIII.—CONSTANTINE, MICH.

Constantine, Michigan, in lat. 41° 53′ N., long. 85° 41′ W., is on level ground, on the St. Joseph River. Settled in 1828, it was incorporated in 1861.

Water-works were built by the village in 1878, taking the supply from Fawn River, a tributary of the St. Joseph, a dam across which affords a water-power of 15 ft. head, one-twelfth of which is owned by the village and is used to drive a double-acting pump which forces water directly into the mains. The ordinary pressure is 25 lbs., and the fire pressure 120 lbs.

Distribution is by 4 miles of Wyckoff wooden pipe, of from 10 to 4 in. diameter, with 37 fire hydrants, 18 gates and 41 taps. Service pipes are of galvanized iron.

The population in 1880 were 2,100. The consumption is not stated. The works have cost $20,500. The bonded debt is $10,000, at 5 per cent. interest. The expenses in 1881 were $250. Most of the distribution pipe were not laid until 1882, and the revenue is not yet fairly established. The works are managed by the village council.

CCCCIX.—CARLISLE, PA.

Carlisle, Pennsylvania, in lat. 12 N. long. 77° W. is in a broken and rocky region. It was settled about 1750 and incorporated as a borough in 1782, and the charter amended in 1814.

Waterworks were built by a private company in 1854 after plans of A. T. Smith, taking the supply from Conodguinnet Creek three miles from the town. A dam across the stream furnishes power to drive a Leffel turbine of 6 ft. diameter, with $4\frac{1}{2}$ft. head and fall, operating a horizontal piston pump of 800,000 gallons daily capacity, made by F. Gardner, which lifts the water 125 ft. through 6 in. cast-iron pipe to two reservoirs built in excavation and lined with brick masonry, each 124 by 132 ft. and 12 ft. deep, on a hill midway between the pumps and the town, and 74 feet above the town.

Distribution is by 12 miles of cast-iron pipe of 8 in. diameter from the reservoir to the heart of the town, and the rest from 6 to 3 in. diameter, with 61 fire hydrants, 20 gates and 550 taps. Lead service pipes are used.

In the winter of 1881-2 a Dean Brothers' steam pump was added to the pumping works.

The capital stock of the company, which supplies both gas and water, is $82,025. The Borough owns one-third of the stock, and elects three of the nine directors. Prior to 1882 no charge was made for water for public uses, but it is now proposed to charge the borough $250 per year for use of fire hydrants.

The population in 1880 was 6,198. The daily consumption is 125,000 gallons. The bonded debt is $25,000 at 6 per cent. interest. The gas and water works have together cost $99,660.73. The expenses of maintenance for the year ending May 1, 1882, chargeable to water account, were $1,808.19, and the receipt from water rents $5,366.90.

John G. Heiser is the Secretary and Superintendent.

CCCCX.—WELLSVILLE, O.

Wellsville, Ohio, in lat. 40° 30′ N., long. 81° 30′ W., is on the Ohio River. The town is on the "bottom" lands and surrounded by hills rising from 200 to 500 ft. above the river.

Settled in 1823, it was incorporated in 1829.

Water-works were built by the city in 1881, after plans of Edaburn & Cooper, and under superintendence of John A. George, taking the supply from the ground water below the bed of the Ohio River. A crib, 12 by 16 ft. and 10 ft., deep made of oak timbers 8 by 10 in., is sunk in the river, 100 ft. from the shore. In the bottom, eleven 4-in. cast-iron pipes, 12 ft. long, perforated for 3 ft. from the lower end, and the end closed with a pointed wooden plug, are driven 10 ft. into the sand and gravel. Through these pipes, which project upward two ft. into the crib, the water flows into the crib and is conveyed to the suction-pipe.

Two Worthington duplex steam pumps, of $18\frac{1}{2}$ in. steam and $10\frac{1}{4}$ in. water, cylinders of 10 in. stroke, lift the water 334 ft. to a reservoir built in excavation, with the bottom covered with broken stone on 20 in. of clay puddle, and the slopes lined with 4 in. of brick on 15 in. of puddle. It is circular, with bottom diameter 106 ft., and diameter at flow line $17\frac{1}{2}$ ft. above bottom, 182 ft. The pressure in the turn is 120 to 130 lbs. The force main is 10 in., and the distributing main 8 to 4 in. diameter, of cast iron, and some wrought iron of 2 to 1 in. diameter. There are 6 miles of pipe, with 42 fire hydrants, 31 gates and 400 taps. Service pipes are of lead. The population in 1880 was 3,377. The daily consumption is not known.

The works have cost $60,000, which is the bonded debt at 6 per cent. interest.

No statements of expenses and revenue have yet been made.

The works are managed by three trustees. D. D Davidson, one of the trustees, is the secretary.

CCCCXI.—JAMESTOWN, N. Y.

Jamestown, New York, in lat. 42° 8′ N., long. 79° 15′ W., is at the outlet of Chautauqua Lake, on hills rising from the stream to a height of about 200 feet.

Settled in 1810, it was incorporated as a village in 1827.

Water-works were built in 1882 for a private company, by the Holly Manufacturing Company, taking the supply from a well, 21 ft. diameter and 21 feet deep, connected by 100 ft. of 16 in. pipe, with a basin 80 by 120 ft. In the bottoms of these wells are driven twelve 3 in. pipes to a depth of 60 feet, through which the ground water flows into the wells. A Holly engine, with four pumps of 9 in. bore and 27 in. stroke, pumps directly into the mains, with an ordinary pressure of 90 lbs., and fire pressure of 150 lbs. at the pumps. The highest fire hydrant is 165 feet above the pumps.

Distribution is by 13 miles of cast-iron pipes of from 16 to 4 in. diameter, with 100 fire hydrants 39 gates and 375 taps. Three meters are used. The village pays $60 per year for each fire hydrant. Service pipes are of wrought iron coated with coal tar.

The population in 1880 was 9,335. The daily consumption is not yet determined.

The capital stock of the company is $150,000. The works have cost $140,000, and there is a bonded debt of $100,000 at 6 per cent. interest.

A. F. Kent is the Treasurer and Superintendent.

(TO BE CONTINUED.)

CORRECTIONS AND ADDITIONS.—Nov. 4, p. 381, *Gunnison, Col.*—Statistics furnished by D. J. McCanne, Superintendent, who designed the works, differ from those previously furnished by C. E. Gray, Jr., in the following points: A wing dam of timber and stones diverts the water of the river into a conduit 12 by 20 in. inside and 2,700 ft. long, made of red spruce lumber with tongued and grooved joints put together with coal-tar pitch. This leads to the pump well, 16 by 10 ft. The Worthington compound engine has steam cylinders of 12 and 18 in. and water cylinder of $10\frac{1}{4}$-in. diameter and 10-in stroke. The high-pressure engine has 16-in. steam and $10\frac{1}{4}$-in. water cylinder of 10-in. stroke. Water is pumped 185 ft. into a tank of red spruce plank, holding 65,000 gallons on the hillside 165 ft. above the city. In the distribution the company have laid recently 4,000 ft. of wrought-iron pipe. There are 36 fire hydrants, 10 gates and 60 taps. The city pays $100 per year for each hydrant. The daily consumption is 30,000 gallons. The works have cost $200,000. The operating expenses are now $167 per month.

The receipt of statistics, as follows, is acknowl-with thanks: From J. W. Rutherford, C. E., statistics and water rates of the water-works of St. Joseph, Mo. From Thomas Harrison, Village Recorder, statistics of the water-works of Constantine, Mich. From D. D. Davidson, Secretary W. W., statistics of the water-works of Wellsville, Ohio. From J. G. Heiser, Superintendent Gas and Water Co., statistics of the water-works of Carlisle, Pa. From F. F. Davis, statistics of the water-works of Coatsville, Pa. From A. F. Kent, Secretary and Treasurer statistics and water rates of the water-works of Jamestown, N. Y. From D. J. McCanne, Superintendent statistics and water rates of the water-works of Gunnison, Colorado.

THE CAISSON DISEASE.

[From the St. Louis Globe Democrat, Sept. 27.]

The sufferings of Chief Engineer Roebling, of the East River bridge, New York, from the caisson disease, recall to mind the trouble that was experienced here in the building of the structure across the Mississippi, when the men employed in the construction were stricken down with the malady. Three of the four piers of the St. Louis bridge are in the river, and had to be built on caissons made of very thick iron with an air-chamber. To reach this air-chamber the men descended a flight of circular stairs in a shaft in the centre of the pier. On arriving at the bottom of the pier they entered what is known as the air-lock by a door at the north side of the shaft. The air-lock was a cylinder 6 ft. in diameter and 6 ft. high, made of very thick iron. Besides the door leading to it from the shaft, there was another door at the east side of it that led into the air-chambers. After the bed of the river was reached, men worked in the caissons at clearing away the sand and earth, so that the piers could rest on solid rock. Once the rock was reached the caissons had to be filled in with concrete so that the piers could rest on the rock and solid masonry. The lower the caisson was sunk the greater was the atmospheric pressure, and when the east pier touched the river bed the pressure was 17 pounds to the square inch, exclusive of the 15 pounds ambient atmosphere. It gradually increased, and when the east caisson touched the rock on the 28th day of February, 1870, the pressure was 45 pounds to the square inch, and by the rise of the river during the months of March and April it was increased still more, the pressure being 50 pounds to the square inch on April 12. As so great a pressure of air could not be otherwise than injurious to the men at work in the caisson, they were only worked for two hours when they were relieved for two hours, and this was kept up for 12 hours, so that they were in the chamber but six hours a day. After the caisson of the east pier had been sunk 15 ft. in the sand, and the pressure had reached 24 pounds to the square inch, the men, after coming out of the air-chamber into the air-lock, or after leaving the air-lock and returning to the normal atmosphere, commenced to suffer very severe pains in the arms and legs, and sometimes shooting pains in the back.

When the caissons had sunk to a greater depth, and there was a pressure of 34 lbs. to the square inch, the men became more seriously affected, some with violent epigastric pains, others with paresis, and still more with slight paraplegia, of which they generally recovered in 24 or 48 hours. Sometimes the paraplegia was more severe, and some of the men were taken with still more serious symptoms. Notwithstanding the existing paralysis, some of them complained of violent pains about the middle of the spine and radiating in every direction of the lower half of the body. As soon as cases happened means were devised at the bridge to relieve the sufferers if possible, even temporarily, and afterward they were sent to the City Hospital. The first case sent to the hospital was on the 15th of February, 1870. Some died shortly after their arrival at the hospital, and some after a sojourn there.

After the recurrence of such facts and accidents, physicians were called at the bridge to see the men at work, when taken sick, which was generally the case when coming out of the air-lock, or after returning into the normal atmosphere. None were taken sick in the air-chambers, and the sufferers were generally taken in a few minutes to one hour after they returned into the normal atmosphere, and in two cases only did it occur in the air lock, as soon as the door opened into the normal atmosphere, and not in the air-chamber or caisson.

Dr. Jaminet was placed in charge of the men at work in the air-chambers April 1, 1870. He had descended into the caisson several times before with other gentlemen, and experimented upon the effect upon himself and others, and knew the exhausting effects. On one of his visits to the caisson, Feb. 28, he remained two hours and forty-five minutes in the air-chamber. The caisson had then touched rock, and was 95 ft. below the river surface, and the pressure of the air was 45 pounds to the square inch. The temperature in the normal atmosphere was 84°; at the bottom of the shaft it was 48°. It rose to 68° when the doctor entered the air lock, and fell again to 43° on entering the air-chamber. His pulse rose from 82 beats to the minute to 102 in the air-lock, but again fell back to 82° in the air-chamber. His respiration was 21 per minute. After leaving the caisson and returning to the top of the pier his pulse rose to 110 beats per minute. He had to rest several times going up the stairs, so exhausted was he, and he almost fainted when he reached the top of the pier. It was with the greatest difficulty that he managed to reach home, and when he did he fainted several times, and lay for hours in a helpless condition, suffering the most acute pains. He was paralyzed and unable to move himself. He took frequent doses of Jamaica rum, beef tea, and also used ice. After several hours suffering the pains began to leave him, and he slept a little. It was a week, however, before he had fully recovered his strength.

On taking charge of the men he had their time changed so that after working two hours they would be given three hours' rest before returning to the caisson. They still, however, continued to work six hours per day, the only change being an hour's longer rest after each interval of work. The men were made to remain 16 minutes in the air-lock before entering the air-chamber, and eight minutes in the air-lock again before returning to the outer atmosphere. This was giving them a minute to every six pounds of pressure going in and a minute to every six pounds of pressure coming out. A floating hospital was arranged at the east pier, and the men were taken to it as soon as stricken down, and attended. No case occurred under his system until April 4. It was noticed that the men suffered greatly from exhaustion. It was also observed that whenever a man took sick immediately after leaving the air-chambers, his pulse was 95 to 115 per minute and very feeble.

When, however, it happened that they did not take sick until a lapse of 20 minutes or longer, the pulse was very slow, often being as low as 60 per minute. In both cases they were covered with cold profuse perspiration. In most of the serious cases the legs were cold and the skin clammy. The temperature was otherwise unchanged. The face was pale and livid and the lips discolored, but the pupils remained unchanged. After the patient had been lying down five or ten minutes at perfect rest, with his legs more elevated than his head, this all changed.

Dr. Jaminet directed that the workingmen, as soon as they came up from the air-chambers, should rest and keep quiet for an hour, and if any were taken sick his treatment was as follows: The patient was put in bed, lying on his back or right side, the head low—level with the body—the legs stretched, the feet elevated at least one foot above the head, and all clothing loosened. He prescribed half an ounce of the following cordial, which always relieved the violent epigastric pains:

R. Spiritus Jamaicensis, viii. fluidounces.
Syrupus simplex, ix. fluidounces.
Oleum anisi, ii. fluiddrams.

After taking this cordial, and from 5 to 10 minutes after, it was followed by two tablespoonfuls of beef tea (made with Liebig's extract of meat in the proportion of one dram to six ounces of boiling water), two tablespoonfuls were given from 5 to 10 minutes, and as the patient always after a while complained of thirst, ice was freely used, but no water or any other drink was allowed for at least two hours. The beef tea was continued regularly; the position of the patient was still adhered to; but afterward the legs were left in the most comfortable position as soon as the pulse was getting stronger and less frequent—that is to say, for the cases where the pulse was over 95 per minute and feeble, and more frequent in the cases where the pulse had fallen as low as 60 per minute. Then, and not until then, was the patient allowed to change his position.

The necessity of placing the patient on his back with the head low and the feet elevated was to send more stimulus to the brain and prevent a return of syncope, which sometimes happened, and which, if repeated in a state of exhaustion, might have had a fatal termination. And when the position was alternately changed from the back to the right side it was to relieve the spine, and at the same time to let the heart resume its regular function, which was more or less disturbed at the time the patient was taken sick. No bath of any kind was given to any of the sufferers, having been positively forbidden.

At first Dr. Jaminet was unable to control the men when coming up from work, and instead of resting as directed they would insist on moving about, and many of them went ashore and drank very freely. As a consequence 32 cases occurred between April 4 and April 25, but after that the doctor got control of the men and the cases were less frequent. Out of the 28 cases which occurred during the sinking of the east abutment caisson 27 recovered completely and many returned to the same work. The only death which occurred was caused by the failure of the men to follow the directions laid down for the men working in the air-chambers. It was demonstrated that men of low or medium stature, well built, single and of steady habits stood the work best. Dr. Jaminet thinks that if every man is properly examined as to his fitness before being placed at work, and the proper precautions are taken, there need be no fatal cases of caisson disease.

NEW YORK, WEST SHORE & BUFFALO RAILWAY.

The construction of this new Trunk line continues to progress very rapidly and satisfactorily between Weehawken and Syracuse, 278 miles; also on its branch lines to Middletown, 25 miles; and Albany, 13 miles, making in all 316 miles now rapidly nearing completion. At this time about 85 per cent. of the graduation and masonry is completed. On the 8th inst. the interval between the last two "headings" of the tunnel of 3,985 ft. through the Bergen Hill, at Weehawken, was cut through, so that at the present time there is an opening through its entire length, and only about 5 per cent. of the total amount of excavation in it yet remains to be done, which will be completed early in next month. The average force employed upon this tunnel and its approach cuts during the month of October was 425 men, 28 compressed air drills, 2 steam excavators and 4 locomotives. The total number of cubic yards of material to excavate from this tunnel and its approach cuts was about 378,000, of which about 345,000 is now completed. The Haverstraw Tunnel, of 1,600 ft. in length, is entirely completed; and the West Point Tunnel, 2,640 ft., now lacks but 20 ft. of being entirely through, which will be completed before the end of the present month. The small tunnels at Newburgh and Kingston, of about 400 ft. each, are both progressing very rapidly.

Iron bridging to the amount of 12,000 tons is manufactured, and most of it delivered at sites for erection. Erection is progressing rapidly all along the line, not less than 6,000 tons being already in place. Tracklaying is in progress at twelve different points, and about 130 miles of tracks are laid up to this date.

The building of passenger and freight stations, engine houses, machine shops, and the houses and appurtenances for the supply of water and fuel, is also being prosecuted with much vigor at all of the following places: Weehawken, New Durham, Newburgh, Milton, Haverstraw, Kingston, Glenerie, Catskill, Coxsackie, New Scotland, South Schenectady, Coeymans, Canajoharie and Canastota; and at all other points the buildings are being placed under contract just as rapidly as the Engineering Department can prepare the plans and contracts for them.

The total average force employed on the work during the month of October was as follows:

19,300 men, 67 steam and compressed air drills, 19 steam excavators, 3 dredging machines. Equivalent to a total force in men of 23,200. In addition to which were employed 3,450 horses and carts, 32 locomotive engines, 1,438 cars, 14 pile-drivers, 63 steam derricks, 6 steam pumps and 32 tug boats, barges and scows.

WALTER KATTE, Chief Engineer.

WEIGHT OF MEN AND WOMEN.

WEIGHED AT THE TENTH CINCINNATI INDUSTRIAL EXPOSITION, OCTOBER, 1882.

It will be remembered that permission was given the Department of Scientific and Educational Appliances to employ a clerk to record the weights of men and women being weighed on scales in the exhibit of the Howe Scale Company. The sheets containing the record have now been added up and the committee reports as follows:

The object sought was a determination of the average weight of men and women, a fact often required by civil and mechanical engineers. Haswell states that the average weight of 20,000 men and women, weighed at Boston in 1864, was—men, 141½ pounds; women, 124½. We have always thought these weights too low for Western people.

The number weighed at the Tenth Cincinnati Industrial Exposition was		22,155
		Pounds.
And the total weight		3,072,306
Men weighed, 7,467	weight	1,150,108
Women weighed, 14,688	"	1,922,198
Average weight of men		154.02
Average weight of women		130.87

For men this is 12.52 lbs. higher than the Boston average and for women 6.37 lbs. higher.

We also determined with reasonable certainty the average weight of people from the country, independently of the general average. This was rendered possible by the excursions that were coming here at various times from this and the adjoining States, parts of which were weighed.

	Pounds
FOR OHIO.	
Average weight of 141 men was	157.38
Average weight of 179 women was	133.20
FOR SOUTHERN INDIANA AND ILLINOIS.	
Average weight of 124 men was	158.38
Average weight of 193 women was	133.55
FOR KENTUCKY.	
Average weight of 114 men was	158.41
Average weight of 188 women was	133.76

The mean of these averages is so much above the general average as to attract attention. For men it is 5.09 lbs. higher and for women 2.65 lbs. The very high and approximate average of those from Southern Indiana and Illinois and from Kentucky recalls the Kentucky origin of the former.

We are under obligations to the proprietors of the scales for furnishing assistant weighers, thus enabling the work to proceed continuously.

W. A. COLLORD, Chairman.

CINCINNATI, Nov. 1, 1882.

CONTRACTING IN BRAZIL.

It is clear from the events of late years that government contracts in Brazil are becoming very risky enterprises, and it is time that foreign capitalists should know that fact. Complaints have been made here over and over again, but to no purpose whatever. To a government official a contract has only one purpose—the carrying out of certain projects on the government's own terms. The contractor is used simply to furnish the money and do the work; his rights under a contract are neither respected nor observed. He undertakes to accomplish a specified work for a specified sum of money, and then the government deliberately ties his hands, makes him subordinate to official engineers and fiscals, delays his work at will, fines him for infractions of contract caused by its own fiscalizing regulations, changes the plans at pleasure, adopts its own standard of measurement, and then delays or denies payment at its own sovereign will. The government never admits that when it enters into a contract with a private party, that party becomes its equal before the law. On the contrary, the government carries its sovereignty into the execution of all its contracts. And then when the contractor seeks to secure justice in the courts, the government forbids the interference of the court, as was done during the administration of Buarque de Macedo. If other proofs are needed of the justness of these criticisms, we may also refer to the action of the government in the contract for the surface drainage works of this city, in those for the construction of the Bahia, Pernambuco and Rio Grande railways, and in a multitude of small contracts with which every one is familiar.

The only conclusion to be drawn from these occurrences is, that a contract with the Brazilian government has become a very risky piece of business.—*Rio News, Oct.* 15.

THE EAST RIVER BRIDGE.

At the Trustees' meeting on the 13th, the contract to furnish an ornamental railing for the towers around the promenade was awarded to the Composite Iron Company for $2,999.60. H. K. Porter & Co., of Pittsburgh, got the contract for two motors at $4,600.

The total cost of the bridge up to the present time is $14,045,683.86. The receipts from all sources up to date are $14,072,703.16. The outstanding liabilities are $127,969.26; the cash on hand is $27,019.30.

President Murphy reported that 668 tons of steel had been received during the month from the Edge Moor Iron Company; that 148 tons were on the way, and that 700 pieces, amounting to nearly 60 tons, were yet to be shipped. He announced that the contract would be finished at the works on the 14th.

Mayor Low and Comptroller Semler accepted on the 13th the proposal of W. F. Pitkin for $200,000 of four per cent. bridge bonds at 103.25, and of A. Dougherty for $36,000 of bonds at 107.

LITERATURE.

The North American Review for December commands attention no less by the eminence of its contributors than by the value and timeness of its table of contents. First, there is a symposium on "The Health of American Women," regarded from three distinct points of view: Dr. Dio Lewis considers the question as it is affected by the prevailing style of feminine attire, especially by the practice of tight lacing. Mrs. Elizabeth Cady Stanton points out the many injurious influences of social environment; and Dr. James Read Chadwick sets forth the effects of education, climate and food, and finally discusses the question whether the modification produced in the European human type by transfer to America lessens the fertility of women. Gov. Buren R. Sherman, of Iowa, writes of the "Constitutional Prohibition" of the liquor traffic in that State, and maintains that the measure is in entire accord with the traditions of the original settlers, and approved by men of all political parties and all nationalities. General Grant, in an article entitled "An Undeserved Stigma," states the facts of Gen. Fitz John Porter's case, and argues that the sentence of the court martial that cashiered him was based on a misconception of the essential circumstances. Richard A. Proctor writes of "The Influence of Food on Civilization," discussing with much learning and force some of the most interesting sociological problems of the present day and of the near future. Prof. Fisher, of Yale College, in defining the causes of "The Decline of Clerical Authority," holds that this decline, which affects the status of church and minister only as a part or function of the secular State, is by no means to be regretted, and that the spiritual influence of the church and its ministry is to-day greater than of old. Finally, there is a symposium upon the conditions of "Success on the Stage," the contributors being six of our most prominent actors—John McCullough, Joseph Jefferson, Madame Modjeska, Lawrence Barrett, Maggie Mitchell and William Warren.

NOTE

TIME BY TELEGRAPH.—The Time Telegraph Co. has introduced a system of clocks by which it is proposed to furnish railway stations, public institutions, business houses, places of amusements, etc., with correct time at a moderate cost, varying from 25 cents to $1 a month, according to the character of the timepiece. The system is practically the same as that already introduced in Paris with complete success. The pendulum of a central regulating clock, which stands in the company's office and runs exactly according to time as furnished from the National Observatory at Washington, opens and closes an electric circuit with every beat, or once a minute if desired. This circuit may pass through any number of clocks, situated all over the city. Every time the circuit is closed a magnet in each clock causes the wheel which carries the minute-hand on its pinion to advance one tooth. Most clocks will be supplied with minute-hands only, but where second-hands are needed the circuit will be closed every second.

The first regulator made for the company is now in their offices in the Kelly Building. It was made by Professor Eggleston, of Columbia College, and runs by electricity—a magnet which alternately attracts and repels the pendulum, causing it to swing back and forth, thus doing away with weights and springs. The company proposes at present to put one regulator in each block, so as to avoid having to cross streets with their wires; but eventually the whole system will be regulated from one central clock. The clocks to be furnished are handsome but very cheap, the cases being of glass and in one piece. The movement is simple, composed of a magnet and a simple ratchet movement, so that there is no danger of the machinery getting out of order. The clocks will do their work correctly so long as the batteries are kept in working order, and it is not expected that they will need replenishing more than once a year. The Pennsylvania Railroad Company, after testing the system for more than a year, has decided to introduce the clocks all along its line and run its trains by them. The importance of having the time in all public places, in hotels and railway stations the same, is too self-evident to need argument. The company is now at work putting in clocks in the block bounded by Beekman, Nassau and Ann streets and Park Row. —*New York Evening Post Nov.* 10.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Equitable Gas Co., of New York.—"Considerable sensation is likely to be created by a new company incorporated under the law of the State of New York and under the name of the Equitable Gas Company of New York. The officers of the company are Edward Sterne, President and J. R. Keene, Vice-President. Messrs. Brewster, Archbold and Rockefeller, all of the Standard Oil Company; E. N. Dickerson, the lawyer, and E. Jermanovsky, the engineer, compose the Board of Directors. The company is a close corporation, and the whole capital, $2,000,000, has been subscribed for by the promoters. The object of the company is to produce gas by the decomposition of steam and liquid hydro-carbon on highly heated lime. Almost pure hydrogen is thus obtained, the lime, used over and over again, being constantly revivified by heat. The hydrogen thus produced is carburetted in the usual way, and gives a gas of between thirty and fifty candles power. All former attempts at producing hydrogen gas on a large scale for illuminating, heating and other power-producing purposes have utterly failed on account of the high cost of production. The main feature of this process is rapid production at very low cost and with very little labor. The process is the discovery of that old genius, Tessié du Motay, who died some two years and a half ago in a lodging house in Twenty-sixth street—and died poor, of course. In partnership with a young Polish engineer of the name of Jermanofsky, the famous French chemist took out a patent for his process. Mr. Jermanofsky has been working ever since the death of Tessié du Motay to perfect this process, and obtained results which were brilliantly illustrated at the exhibition given at the experimental works of the Municipal Gas Company on Tuesday last. Officers of different gas companies were present, and expressed unqualified admiration of the new process. All publicity in regard to the scheme has been avoided, and it was with considerable difficulty that this information was obtained, the object of the promoters being 'to keep the whole thing to themselves.' The company has become the owner of an exclusive license for the city and county of New York, and as soon as the necessary buildings are erected will supply the city with the new gas, at considerably reduced cost to the consumers. The Municipal Gas Company, of which Mr. E. Stern is the originator, has secured a free license for the consumption of the new gas. 'The brilliancy of our gas, and its low cost of production,' said an officer of the company, 'will make it the most formidable competitor of electric light, even should that light become an absolute practical success. Our gas will be so cheap that it will be used for fuel, and in a very few years you will see it substituted for coal on steamboats and railroad engines, if not in kitchens. We shall knock down the price of coal, too, for we furnish a clean, unsmoking substitute for it, and don't use a ton of coal ourselves. All the heating we want is done with oil.'

"The process has been patented in every country, and the great Paris banking house of Baron Sellière is conducting the negotiations for the introduction of the new gas in Russia, Germany, Austria, France and Italy. England and Belgium being the two great coal-producing and coal-consuming countries, the patentees have as yet reserved to themselves all negotiations for them."—*N. Y. Sun.*

Croton Water Meters.—According to the decision rendered on Monday by the Superior Court, Special Term, the Commissioner of Public Works may have meters put in "all stores, workshops, hotels, manufactories, public edifices, at wharves, ferry houses, stables and in all places in which water is furnished for business consumption by the Department of Public Works, except private dwellings." Whether a meter shall be put in any building or not is a question whose decision rests solely with the Commissioner, except that a court will interfere to prevent any abuse, injustice or oppression. But the pattern and cost of the meter must be approved by the Mayor, the Comptroller and the Chief Engineer of the Croton Aqueduct. In the case before the court it appeared that the water used for business purposes was drawn from a well, and that the Croton water was used only for drinking, washing, etc. It was accordingly contended that the owner of the premises could not be charged with the cost of putting in a meter, as no Croton water was used for business purposes. But the Court decided that meters may be put into any of the kinds of building specified, when the occupants have it within their power to use more than the usual allowance of water. "The power and the temptation," says Judge Freedman, "to use the Croton water in their business exists, and the Commissioner of Public Works is not to be expected to provide and maintain an efficient system of espionage or regular inspection at short intervals to prevent them from making the most of their opportunity. It is the office of the water meter to prevent such a result."—*New York Herald, Nov.* 15.

Hyde Park, Ill., is discussing the question of adequate street illumination. The gas works are inadequate and it seems probable that electricity will be tried.

A petroleum pipe line constructed from the Couban oil territory over the Caucasus mountains to Novorossisk harbor, on the Black Sea coast, is 105 miles long, and can deliver every day 1,000,000 lbs. of petroleum.

ELECTRICITY.

The Cairo (Ill.) Electric Light and Power Company has been incorporated. Capital $10,000.

The Freeport Electric Lighting and Power Company of Freeport, Ill., has been incorporated. Capital, $25,000.

A Canada Electric Company.—Application has been made for the incorporation of the Canadian Magneto Electric Light Company. Capital $100,000.

RAILROADS.

Bolivian Railways.—The latest advices from Bolivia announce that a most important railway project has been presented to the government by two Argentine citizens, Messrs. Rossetto and Aurrecochea, who have proposed the construction of a railway from La Paz to the frontier of Saquixea, joining with the Argentine Central Northern. The city of Sucre would be connected by a branch line with the railway, as well as Potosi. Thus the railroad would start from the centre to the south of Bolivia.

The branch line from Sucre to the main line would be a tolerable easy work, but the extension to Potosi would have to take a roundabout route to avoid the great difficulties of the surrounding mountainous country. The proposed line would thus unite the principal cities and richest districts in the republic of Bolivia and facilitate the transport of the greater bulk of produce to the port of Rosario along the Central Northern and Central Argentine. At present all the produce of the southern provinces of Bolivia is transported by bullock-carts to Tucuman, a long and tedious journey, and most expensive means of transport.

The contractors propose to construct the line without any subvention from the government and request no guarantee whatever on the capital. They only ask for the concession of 24 square degrees of national lands. The government thus goes to no expense, and the railway will be worth more to Bolivia than all her public lands.

The proposal of the concessionaires is so advantageous that the Bolivian government and Congress will no doubt immediately sanction it; but the success of this enterprise hinges more on the foreign capital than on the efforts of the Bolivian government. The Bravo scheme is yet remembered by all, and that gigantic concession fell through owing to want of confidence abroad. —*Buenos Ayres Standard, Sept.* 28.

The Canada Southern Railroad has been leased to the Michigan Central Railroad Company for 20 years.

Grading in Pennsylvania.—The grading of the Phœnixville & Westchester Railroad is being pushed with great vigor.

A Western Road.—Ground was broken for the San Francisco and San Rafael Broad Gauge railroad at the mouth of the 1,900-ft. tunnel. The contract includes three tunnels, 1,900, 1,050, and 600 ft. in length each. When the road is completed, San Rafael will be within fifty minutes' ride of San Francisco. The road will come to deep water at Point Tiburon, just above Saucelito, and is the commencement of vast improvements. The contractor intends to finish this part of the road within one year.

Work on the Killbuck Valley Road Progressing.—Wooster, O., Nov. 9.—The work of grading the Lake Erie, Wooster & Muskingum Valley Railroad, more commonly known as the Killbuck Valley Road, between this place and the New York, Pennsylvania & Ohio Road, at Burbank, is progressing rapidly. Over half of the 15 miles is all graded and ready for the ties. The worked is being pushed forward with a large force of hands, and it is expected to have the road-bed ready for the rails by the 1st of January. The completion of this little road is now assured.

The Mexican Southern Railroad will start at Anton Lizardo, where the company now own a very large tract of land, where a harbor can be formed very cheaply, and where the new port of entry, "Grant City," is expected soon to rise. Thence it will run, via Arenal and Puebla, to the City of Mexico, and from Arenal, via Oaxaca, to the Isthmus of Tehuantepec. Regular freight trains are now running between the City of Mexico and Toluca.

A New Pennsylvania Road.—A charter has been granted to the Gettysburg & Emmittsburg Railroad Company, which is authorized to build a road, six miles long, from a point of connection with the Round Top Railroad, at its terminus at Round Top, Adams county, to a point on the Pennsylvania and Maryland State line. The capital stock is $60,000.

A New Illinois Road.—The Roodhouse & Scottsville Railroad Company has been organized. Capital $200,000. The projected road is an important branch of the Burlington & Ohio River, which is now being rapidly built from Gillespie to Scottsville. Track-laying is in progress from Gillespie toward Carlinville. This will complete the new Kansas City short line east via the Chicago & Alton and the Cincinnati, Cleveland & Columbus and Indianapolis & St. Louis from Roodhouse to Gillespie.

Three thousand tons of steel rails have been loaded on barges at Pittsburgh ready to go South on the first high water. Two thousand tons go to Anthony Ferry, Yazoo River, to be laid in Sharkey county, and 1,000 tons to New Orleans, for the road between that city and Baton Rouge.

Duluth & Winnipeg.—The surveyors on the Duluth and Winnipeg lines are cross-sectioning at a point eighteen miles from Duluth. The road is to extend 300 miles due north from Duluth to the Manitoba boundary line. Graders are at work about eight miles from Duluth. The country is rocky and woody, notwithstanding which the cost is expected to be only $20,000 per mile. Work was begun last winter.

Surveying Commenced.—A party has commenced the survey of the Chicago, Indiana & Ohio River Railroad. The line will run from Hammond to Terre Haute, Ind.

A New Elevated Road Company.—Boston, Nov. 18.—J. V. Meigs has petitioned the Legislature for the incorporation of a company with authority to construct and maintain an elevated railroad in any city or town in which the authorities may grant leave, the capital stock of the company to be $1,000,000.

Nearing the Rio Grande.—A note from San Antonio, Tex., of Nov. 10 says: The Eagle Pass Branch of the Galveston, Houston and San Antonio Railway will reach the Rio Grande tomorrow. Contractors are here making terms for the construction of the work on the Mexican extension of this line.

Work has been commenced on a street-car line for Monterey, Mexico.

Projected Southern Road.—A new road, called the Louisville & Southern Railway, is projected, to run from Louisville to Danville, O. A part of the line has been surveyed.

CANALS.

Surveyors are at work on the Hennepin Canal.

Builders of a New Ship Canal.—Wilmington, Del., Nov. 18.—Gen. Horace B. Tibbetts, President of the Delaware & Maryland Ship Canal Company (Sassafras route), in company with Gen. Gulielmo Naune, President of the Central American & Nicaragua Railroad; Col. G. M. Totten, Consulting Engineer of the Panama Canal; M. A. & H. B. Slaven, of the American Dredging Company, and one or two others, representing a syndicate of European capitalists, has been down the State inspecting the proposed route for a ship canal between the Delaware and Chesapeake, and left here for Philadelphia this afternoon. The estimated cost of the canal, which would be about 110 miles long, is $6,000,000. Gen. Tibbetts is reported as saying that they are now ready to go to work, and that the canal will be pushed to completion without asking Government aid.

Canal to Pullman, Ill.—The Chicago *Times* says: It can be announced that a very important move in the interest of the Calumet region will be made Monday, it being the commencement of work upon the much talked of canal which is to connect the Calumet River at Cummings with the Calumet Lake at Pullman. For some time the project of building a canal at this point has been agitated, and its necessity has been obvious. As it is at present, the Calumet River winds around to the south and west so that it is about five miles from the mouth of the river in South Chicago harbor to where the river enters the Calumet Lake at its southern extremity. A vessel to reach Pullman would then have nearly two miles more to go, as that city is located near the northern extremity of the lake. The canal as projected is to be about half a mile in length from river to lake, is to be 100 ft. wide and 16 ft. deep.

BUILDING.

Ventilation of the Guildhall.—Messrs. Boyle, of Holborn Viaduct, have just fitted this ancient chamber with sixteen boxes, technically known as "inlets," which are heated by gas-jets artfully concealed in the wall. These inlets are in direct communication with the outer air, which is thus warmed before reaching the chamber. By an arrangement of pipes within the box the water which is condensed by the atmosphere of the chamber is collected and drawn off. A temperature of 60 degrees to 120 degrees can be obtained with the apparatus. Nine air-pump ventilators are placed upon the roof of the chamber for extracting the vitiated air.—*London Ironmonger.*

Texas State Capitol.—The capitol contractors expect to commence work Dec. 1.

Pontiac, Ill., is to have a new city-hall.

Capitol Extension.—The annual report of Edward Clark, the architect of the United States Capitol, shows that the amount expended for capitol extension during the last fiscal year was $57,000; for lighting the capitol and grounds, $80,000; for care and improvements on the same; $60,000; for extension of the government printing office, $40,000; enlarging the Washington court-house, $117,000.

BRIDGES.

The New Bridge of the Chicago & Great Southern road at Attica, Ind., which road runs from the coal fields of Parke County to Chicago, is under full headway, quite a large force of men being at work on it. The work of laying the track from Oxford, Benton County, is going rapidly forward.

MISCELLANEOUS.

There are now in the United States fifteen Bessemer steel works, with 87 converters that are capable of producing in the neighborhood of 2,000,000 tons of Bessemer steel annually.

The purchases of barbed wire on the part of the American farmers, according to the Washburn & Moen Company, the largest makers, amount in 1874 to 10,000 lbs. made and sold; in 1875, to 600,000 lbs.; in 1876, to 2,840,000 lbs.; in 1877, to 12,863,000 lbs.; in 1878, to 26,655,000 lbs.; in 1879, to 50,337,000 lbs.; in 1880, to 80,500,000 lbs.; in 1881, to 120,000,000 lbs.; in 1882, to 160,000,000 lbs. The total of 456,805,000 lbs. represents 414,484 miles of efficient barbed wire fence three wires high.

The Potomac Flats.—A Washington dispatch of the 16th states that the bid of P. Sanford Ross, of Jersey City, has been accepted as the lowest responsible bid.

HOW SHALL A YOUTH BE TRAINED FOR THE OCCUPATION OF AN ENGINEER?

INDIANAPOLIS, Nov. 2, 1882.

TO THE EDITOR OF THE RAILROAD GAZETTE:

My advice having been asked in a matter upon which I cannot speak confidently, I have stated my position and promised to seek your assistance, expressing at the same time the confidence I feel in your judgment in such matters.

The case is this: A young man (Canadian) of 19, to be graduated in July at the Military College, Kingston, Canada, intending to adopt the profession of civil engineer, and to "make a specialty of railway construction and management," is considering seriously how the next year may be employed to his best interest "in the long run." He has under consideration.

1. Going into the field "under the direction of an experienced engineer."

2. Spending a year "in the workshops in Canada, the United States or in Europe."

3. Entering a mechanical school in the United States, France or Belgium.

The immediate income to be derived from the first and possibly from the second is not wholly a matter of indifference to him, yet he can forego it for any great professional gain in any other course. He thinks the advantage of the scientific lectures in France and Germany and the opportunity to perfect himself in the languages of those countries should, perhaps, be considered in connection with the foreign workshop or mechanical school.

Your opinion on the subject will be appreciated as a particular favor. S.

Some comments on the subject of this letter, by the editor of the *Railroad Gazette*, will be found in the following article on

THE EDUCATION OF ENGINEERS.

The excuse for saying anything about this rather threadbare subject will be found in the letter of inquiry above, in which the writer asks for "assistance" to aid him in advising "a young man, intending to adopt the profession of civil engineer" concerning the completion of his education. As similar inquiries are frequently made, it has seemed proper to write what may perhaps answer the other similar questions, or interrogative thoughts, which are entertained by persons interested in the same subject.

It may perhaps clear away some ambiguity and enable the young man who is seeking an education, and those who are about to advise him concerning it, to get a clearer view of what ought to be aimed at if he and they will form a more definite idea of what his career and occupation is likely to be than is indicated by the term "civil engineer." The opinion has heretofore been expressed in these columns, that it would be a distinct advantage to "the arts of directing the great sources of power in nature for the use and convenience of man," and to those who are engaged in the practice of such arts, if the word "engineer" and its derivatives could be entirely eliminated from our language, or their use be abolished. The term "civil engineer" has about it what Edward Everett would have called a "sonorous amplitude" of sound and meaning. It seems to mean more than it does, and experience soon teaches that the occupations it includes, instead of having about them a sort of super-exalted character, are usually very common-place indeed. It sounds well for a young man to say that he intends to be a "civil engineer." Fond mothers like to tell their intimate friends that Edmund intends to adopt that "profession." There is a rhythm about the name of it that makes it agreeable to tell to Angeline in soft and confidential tones, and she is apt to think that it produces a good impression to speak of the favored one as a "civil engineer," when the diamond or plain gold ring first makes its appearance in public. The word engineer carries with it many illusions, which, under such circumstances, it is rather pleasant to entertain, but which, if dispelled, would make the occupation much less attractive than it now is to many young men. In fact, it is only necessary to specify what the work of any engineer really is, and the illusions begin to fade away at once. Thus, accompanying the letter of inquiry was the card of the writer, whose firm is engaged in practical engineering work. On this card it is announced that they do railroad and other grading, difficult foundations, heavy masonry and steam pile-driving. Now assuming that the term "civil engineer" is banished from the language, and that our aspirant is aiming to qualify himself for doing the kind of work that this firm is engaged in, and that his aim is to get such an education as will best qualify him to become a railroad grader, to build foundations, to become a stone mason or a pile-driver, would not the question of the kind of education he ought to seek assume a very different aspect from what it does when he is aiming to become a "civil engineer?" Nevertheless, grading, building foundations, heavy masonry and pile-driving are branches of civil engineering.

But it may be said, that while this is true, the kinds of work named are only some of the branches of civil engineering; that they are not the only work of the "profession," that there is other work in which a thorough knowledge of mathematics and other science is required, and for which a person cannot be qualified who has not had a very complete theoretical training. Unfortunately for some of the theories regarding technical education, this statement is not true. There is not a branch of civil or mechanical engineering now practiced in this country in which the men who have achieved either the greatest distinction or pecuniary success have had a liberal education either classical or technical. If we turn to the special branch to which our young aspirant is looking, that of railroad construction and management, probably not one-fiftieth of those who now occupy prominent positions of that kind in this country have had anything approaching to what we call a liberal education. This shows in an indubitable way that such training is not *essential* to the success or to the attainment of distinction in these occupations. As a matter of fact, what can be learned in a common school is sufficient to enable a man to become eminent or successful in any branch of engineering. It is not said that a greater degree of knowledge of science or of literature, more skill in the use of language, or more education generally, may not be an additional help to an engineering aspirant.

The truth is, though, that in comparison with other qualifications, the value of any high degree of mathematical or scientific training is very slight. If the relative usefulness of different amounts of education were laid out graphically, so that its value would be represented by the height of vertical ordinates, a curve drawn through the different points laid down would probably assume the form of a semi-ellipse, with the conjugate axis for a base. The beginning of education would be seen to be of prime importance, and the curve would ascend almost vertically. When the elements are mastered, the curve would begin to incline from a perpendicular, and as the common school period is passed the inclination would probably be about 45°, and with the beginning of the course in a technical school the curve would approximate more and more towards a horizontal line and the rate of vertical increase would be less and less until it would begin to descend, slowly at first, but after a certain amount of scholastic training has been attained the rate of descent would be certain and after a while rapid. In other words, there is a degree of book learning which is an actual detriment to any one who engages in the occupation usually included under the general head of engineering. But when this period is reached our elliptical curve approximates so closely to a horizontal line for such a long distance and then ascends and descends so little above its base that it is not worth while to attempt to fix exactly the point at which it would intersect the transverse axis even if it were possible to do so. What we want to make clear here is, that so far as an aid to success is concerned it is the beginning of education that is the most important. After that additional attainments are a help, but their value soon begins to diminish and, after a certain point is reached, more study hinders and does not help to advancement. Those inclined to demur to this statement should, however, not infer more than is expressed. All that is asserted is, that so far as the achievement of success—that is, making money by honorable means—is concerned, the higher technical education is of little or no help. But there is something else in life worth having besides money and the power which it gives. To any one with a liking for what are called engineering occupations the pleasure to be derived from a thorough scientific and technical education would, to many people, outweigh all the pecuniary sacrifice which it would be necessary to make in getting it, and in the subsequent loss for having neglected other and more effective means of achieving what is ordinarily called success.

It will be well, though, if our young friend should at the outset make a distinction, and determine exactly what he wants most to get. The question might be stated somewhat in this way: the more knowledge he acquires beyond a certain point, the less money will he be able to make. Now it will depend altogether upon his tastes and circumstances as to what course it would be best for him to follow. If he has such a love for science and of knowledge as would make the possession of it a source of great pleasure to him during his whole after life, then we would by all means advise him in selecting the three alternatives named to select the last and take as thorough a course in one of the schools as he can afford time and money for. If, on the other hand, it is important or desirable for him to earn the most money in the least time, and if he has a fair elementary education, can use his own language with reasonable correctness, knows algebra, geometry and trigonometry, with more or less natural philosophy, or "physics," as it is now the fashion to call it, and some knowledge of mechanical drawing, our advice would be to plunge into practice at once.

There is some reason for suspecting, though, that he entertains some of the illusions which were referred to in the beginning of this article. Therefore we advise him never to say or think of becoming an "engineer." We have heretofore quoted the saying of Herbert Spencer, that "Science may be described as definite knowledge, in contradistinction to that indefinite knowledge possessed by the uncultured." In taking the last census in Great Britain those in charge of the work would not accept, as an answer to the question of what a man's occupation was, that he was an "engineer." They decided that the term does not indicate what a person's occupation is with the degree of definiteness demanded by the census. It might be well, then, if our inquring friend were to shape his aims and intentions into a form so definite that the British census-takers would accept it as an answer, if they asked him what his occupation is or will be. Our correspondent speaks of his "making a specialty of railway construction and management." It is to be feared that the British census-taker would not regard that as sufficiently definite. In fact it looks a little as though our young friend was a little vague in his ideas of exactly what he proposes to do. "Railway construction" involves a number of distinct occupations. Does he intend to locate lines where none are built? If so, he better attach himself to some party or "corps"—as they love to call themselves—of men in the field who are doing that kind of work. If he wants to learn about the grading of a line and doing the masonry work for its bridges, tunnels, etc., then he had better join a contractor and study the geometry of earthwork and the characteristics of the mule, gunpowder, nitro-glycerine and Hibernian, Italian and African laborers, with more or less of the literature of strikes. For either of these occupations the amount of theoretical education which has been specified would be sufficient for a fair start. If he aims at a knowledge of bridge-building, then he must keep in mind that, expressed after the manner of a boy's composition, there are different kinds of bridges, those made of wood, those made of stone and those made of iron. Each is a specialty of itself. With geometry, trigonometry and algebra, he can learn how to design and build bridges very much better if he enters the employ of some firm in that line of business, than he can in a technical school. If he means to turn his attention to rail manufacturing, then chemistry would help him, but he could pick up more knowledge which would be useful in a good rail mill than he could in all the laboratories in the world. Besides the mill has the advantage that the young railmaker can in odd hours learn as much chemistry as he will need, whereas the laboratory has the disadvantage that it is impossible, in it, to get the knowledge which the mill alone can teach.

If he means to learn how to take care of a railroad track, let him join himself to a section foreman—if he has the physical strength for it—as a truck laborer for a time; it will develop his muscles and he will learn how much work a man ought to do in a day, and he will get a glimpse of life from a day laborers' point of view, and thus be able to deal more justly with that class thereafter than he could without such experience. The ethics of doing this is not, we regret to say, usually taught in technical schools.

There is another branch of railroad construction, closely allied to rails, which is yearly growing in importance and in complication. That is the construction of frogs, switches, signals, etc. The business of manufacturing these appliances is carried on in special establishments devoted to this kind of work. There is almost no literature on the subject, and what could be learned about it in schools would be worth comparatively little to know. The best place to learn how to make frogs and switches is in a frog and switch shop. It is difficult to learn anything about signals any where, excepting in some of the large establishments devoted to that business in England or in one or two shops of that kind here. If this is impracticable, then the would-be learner must imitate the example of a hungry dog and pick up a morsel of information wherever he can find it, as the dog does his food. It will not do either for the learner in such a case to be too fastidious about the way in which such intellectual food is prepared, any more than the dog is about what he eats. The canine's example must also be followed by cultivating an instinct to discern information as the dog scents his food.

When it comes to the telegraph then looms up the illimitable field of electricity. The science of it which will be most useful to a future railroad constructor or manager could be learned in a few weeks or months in any telegraph office, and the leisure there afforded would give ample time to study up as much of the theory of electricity as will be required in ordinary practice.

Before leaving the permanent structures of railroads, something ought to be said of the stations, shops, water supply, etc. There is no way of getting information about the arragement of these excepting that which is analogous to the one our hungry dog employs in getting his food. There are no schools, no books, no papers and no persons who seem to have any complete understanding of these subjects. The knowledge of building which an architect ought to have is not referred to. The place to learn that is in the employ of some competent person engaged in doing that kind of work.

If our young student means to turn his attention to the rolling stock of railroads, then the best place to learn how to make locomotives is in a shop where they build them. To learn how to manage them he ought to gain some experience in firing and running on the road, and then study the subject by working steadily at their repair in some railroad shop.

The same thing may be said of cars.

If he means to turn his attention to the traffic, or to the financial management of railroads, the office of a traffic manager or the chief executive office of a railroad would be an infinitely better place to learn what could be turned to account than any school could possibly be.

Many very intelligent persons have been advocates of workshop practice in schools. There are two things which it seems in the very nature of things must always make that kind of training very ineffective. First, there is the absence of the rigid discipline and accountability which exists in a well managed machine shop; and, second, the object for which every shop engaged in business exists is absent in the school. That object is the making of money and the production of machinery at the lowest cost and the best quality. In a real shop the learner must come early and work regular hours. He must do a fair day's work, and carelessness is not tolerated. He must in a measure compete with his fellow workmen under a rigid supervision. That kind of training alone is of great value to a young man, and that he does not get while playing at workshop for a few hours a day in a school.

But it may be said that the young inquirer does not want to be a railroad locater, a railroad grader and builder, a bridge-builder, a rail manufacturer, a track master, a switch or signal maker, a telegraph operator or superintendent, a locomotive superintendent, master car-builder or traffic manager. It may be that he wants to get a general knowledge of railroad construction and operation and educate himself for a general manager or a president. Now, if this is the case, there are some rather awkward questions which ought to be considered. Supposing that after he has completed such an education no one should happen to want him for a general manager or general superintendent, what would he do? It is true that competent men are always wanted for such positions, but those whose services are sought are men who have shown by what they have done that they are competent and have the ability to manage affairs. Our student would have no such reputation after he had laid up a stock of "general information," and he might find himself unable to get employment on the top shelf. Now general information would not help him to get employment lower down. What is wanted there is special knowledge. If he wants to be employed to locate a railroad or design a locomotive, he must be able to show that he knows how to do those things as well as or better than other people. In other words, to get employment he must know how to do some one or more things in the best way.

The writer remembers soon after emerging from the chrysalis state of his apprenticeship seeking the help of the man who before that occupied the relation of master to him, in getting employment, and he (the writer) gravely asked his former employer what position the latter would advise the emancipated apprentice to *take*. The old man hesitated a moment, and then with an expression on his face like that which General Butler probably assumed on hearing the news of the late election in Massachusetts, advised the writer "to take whatever position he could get."

During the same apprenticeship there was a philosopher workman who "run" a drill-press next to the writer of this too long article. He was given to saying that "in order to get on in the world a man must conceive himself to be a wedge, and when he sees an opportunity he must insert himself." We will finish this article by advising our friend in search of an education, first to abandon the use of the term civil engineer; it will clear away some things that are foggy now; next: to learn to do some one thing, like locating railroads, building bridges, or making signals, or repairing cars as well as or better than any one else; then take "whatever position you can get," and after that conceive yourself "a wedge," and look out for opportunities.

Of course if a young man has wealth and influence and is independent of his own achievements, then the case might be different, and merely for the pleasure it would give a thorough classical or technical education might be advisable. The present or late president of the British Institute of Mechanical Engineers, who is a partner of Sir William Armstrong, determined a year ago in educating his son to succeed him, first to put him in the shop and then give him a classical course at Oxford.

The great practical advantage of an education in "railway construction" is the discipline it gives to the mind, so that the person has the free use of his intellectual faculties, as a gymnast has of his muscles.

Much less training than that of a full course in a technical school or college gives this to a sufficient degree for all the practical purposes of success in what ought *not* to be called the engineering occupations.

To the Editor of the Railroad Gazette:

Your valuable paper has an editorial article, "The Education of Engineers," in the issue of Nov. 10, 1882, some parts of which the writer, as a civil engineer with over thirty years' experience, cannot read without an earnest protest.

I have enjoyed your paper for years. Why? Because it treats of many of the various topics which interest the civil engineer who "makes a specialty of railway construction and management."

Is it not as competent for a civil engineer to know personally and practically of these subjects, as for a *Railroad Gazette* to collate and print concerning them?

Your editorial *asks* too narrow a view. Civil engineers of the past twenty years have had good knowledge of all the various points it touches upon, and many more besides, and the best of them did not get their reputation by following any *one* of the footsteps you mention.

My answer to the young man who "intends to adopt the profession of *civil engineer*, and to make a specialty of railway construction and management," who has graduated at the Military College, Kingston, Canada, and is seriously considering how the next year may be employed to his best interest in the long run, is his *first* alternative, premising that he has profited by his opportunities, is a good mathematician and draughtsman.

"Going into the field under the direction of an experienced engineer."

Why? He does not ask to become a mechanical engineer. If that were his desire, then take his second alternative, and after two or three years of work he will know what he wants from his third alternative.

Education and practice combined, experience is what he requires, in the line of his query and upon his premises.

By obtaining an inferior position in a field party of engineers, he begins at the beginning of railway construction, soon learns how to obtain data for his own mathematical determinations; as the pleasure of solving peculiar problems not found in books, as well as applying those printed, overbalances the toil and privation of his field work, he acquires the habit of noticing the peculiar features of the country; this increases until after years (not one or two) of practice he imperceptibly acquires a "knack" at combining them which will give his judgment weight with the parties who are investing money, even before he is instructed with the surveys and arrangement of the various and apparently conflicting items which weigh in the balancing of comparative advantages.

Naturally following the surveys, often intermixed with them, and thus, while a young man, he comes upon railway designs and construction. Here he practically sees not only the work of one engineering firm or contractor upon grading, foundations, masonry, bridging, etc., but becomes conversant with the modes of many, and observes which answers best for various localities and different circumstances, and why some contractors lose money in positions similar to these of others who make money; but more than these. Which modes do the work in the *best* manner as well as the ones which are the cheapest, for the cheapest is not always the best. Thence to track-laying, station building, water supply, terminal facilities, and incidentally rolling stock. All of these he can learn, and *will* learn, if intending to become a civil engineer for railway construction. You may inquire of most of our experienced civil engineers (railway), and they will give correct ideas in regard to any of the items you mention, and their ideas will weigh *both* with investors and contractors.

They *must* know these matters experimentally in order to *fill* their positions.

By all means obtain all the theoretical basis possible, then strive for a varied experience.

An *engineer's success is not* "making money by honorable means;" it is the reputation of readily and skillfully adapting the resources of the country to their highest development in the work at hand. A civil engineer may as well at once give up the idea of "making money" strictly in his legitimate profession, but he might, and does, make a fair living, a respected position in the world; *he lives an useful and honorable life.*

It would seem that your writer has lived too long in New York, where (naturally as the financial center) to make money is the aim of the mass. There are other and better objects, objects that expand instead of diminishing the intellect, cultivate and enlarge the mind, enoble the spirit and the life.

Look at our good civil engineers of the past as well as of the present. Many have most worthily *filled* positions requiring intimate knowledge of all and many more than the branches you suggest, being entrusted without oversight, with the expenditure of immense sums of money, because they *knew* what they were about, were not brought up in any one school or corps, with any one contractor, mason, bridge-builder, trackman, manufacturing or engineering firm, but have culled the best from all.

The young man wishes to learn more than the engineering firm specifies that it does, although to do that well is a heavy business of itself.

He wants to include a knowledge of their business and this is why your correspondent of the engineer's firm writes to your paper.

There is a profession of civil engineers and it will be maintained so long as the material world progresses. There are and will be civil engineers for railway construction so long as railroads are designed or built.

Upon any regular meeting of the American Society of Civil Engineers, let a stranger visit their rooms and see the honest, earnest endeavor for the truth in all practical matters. He will see no show, but if he becomes acquainted with the members he will find a vast amount of solid facts and varied experience with the use of those facts.

"A rose by any other name would smell as sweet," but there is the rose, what better name can you suggest? No! the only modifications to the term of civil engineer are those now well understood, which shows the specialties, as railway, hydraulic, mining, bridge, sanitary, mechanical, gas, electric, etc., and a member of either should and does necessarily have a fair acquaintance with the learning and practice of the others.

The name civil engineer should have a sonorous amplitude, for thorough practice in the profession will give such corresponding breadth of vision that the true engineer will find there is always something to learn. All of the world's materials are his resources and all of nature's activities are his agents.

The editorial is generally too discouraging, too narrow for a young man. "There is always room at the top." In order to get *there* one must begin at the bottom of the ladder, and he will find it safer as well as easier to put in *every rung* as he ascends.

Full well I remember the reply to me, thirty years ago, of a civil engineer then eighty years old, when I was as anxious as this young man: "Are there any more railways to be built? Will the business last?" "Never you mind that problem; the older you grow the more you will see to be done, until, at my age, you will think the engineering world just begun."

The last part of your editorial is superior to the rest, but even there I would say for encouragement to the engineers, that, like the usual experience of earnest, active men in other pursuits, there will be times when he will be puzzled what position to *take*, as well as times when he will be glad for anything he can *get*.

As to railway *management*, if administrative or executive ability develops under the extremely favorable conditions of the life of a civil engineer, he will be sought for, wherever promptness, system, accuracy, tact, versatility, decision, broad views, are required. In proof of this, I see many among my engineering acquaintance who now worthily fill such positions, who preferred to deal with men and measures after successfully handling the resources of nature.

Judging from the tone of the article, it was not written by one in the active pursuit of the profession, consequently I intrude upon you from the stand-point of a civil engineer.

ROBERT L. HARRIS, C. E.,

No. 80 Columbia Heights, Brooklyn N. Y. Nov. 11, 1882.

BINGHAMTON, N. Y., Nov. 13, 1882.

To the Editor of the Railroad Gazette:

I have read your editorial on the "Education of Engineers," with much interest and some dissent.

Your remarks on the diffuseness of the term "Civil Engineers," are to the point, and are too true; but to sink the whole term would be only the change from the frying-pan to the fire. It seems to me that the proper cure is to suit the prefix to the occupation, and use such terms as "Construction Engineer," "Bridge Engineer," etc.

Your statement that there is no branch "of civil or mechanical engineering" in which the successful have had a "liberal education, either classical or technical," is largely disproved by the facts. The chief engineers of the first three railroad systems that occur to me are all men of such education. The largest of the three employs engineers of such education by preference.

Your idea that a man must be practically acquainted with the work he is to do before he can be successful in it is self-evident.

Where your advice to young men fails is that you would have them decide their course in life at an age when they are not fit to make the decision. This is, I submit, a fruitful cause of the many misdirected lives that we see. They choose too young. Right here the technical school steps in and fits the young man as the training, which you so aptly refer to, fits the athlete for his life work. The three or four years of severe mental labor mature his mind, quicken his ability to see his way through a difficulty, and perhaps, best of all, teach him where to look for any information he may require. He has stored away a vast index of knowledge. He is now a man ready to choose his special work. Does he intend to locate lines where none are built? He can run transit, level or rod; he can take notes on topography or map the line, not rapidly at first, but surely faster than if he had no such knowledge. If he wants to learn "grading and masonry," is he the worse off for knowing the laws that govern the stability of these materials? "If he aims at a knowledge of bridge-building," a knowledge of how to work strain-sheets and the strength of materials is not far amiss. And so on through your long list of the special branches of the "profession" there is not one in which his training will not be of use to him.

To repeat, there is about as much sense in a boy of eighteen or nineteen—except in rare cases—choosing his course in life as in the unwritten law of our kinsmen across the water that makes the eldest son the heir, the second a soldier and the third a clergyman: they differ but in degree of their unwisdom. A CIVIL ENGINEER.

◆

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 400.)

CCCCXII.—EASTON, PA.

Easton, Pa., in lat. 40° 42′ N., long. 75° 8′ W., on the Delaware River, is on hilly ground between the mouths of Bushkill Creek and the Lehigh River.

Settled in 1738, it was incorporated as a borough in 1789.

Water-works were built by a private company in 1820. No account of these works has been obtained. In 1854 the Lehigh Water Company, which now supplies the town, was organized, and built works after plans of John West, taking the supply from the Lehigh River, and pumping into reservoirs by a Cornish Bull engine, erected 1860. In 1882 new pumping works have been erected after plans of H. P. M. Birkinbine, C. E., taking their supply from the Delaware River, and pumping by a Corliss engine of 2,000,000 gallons daily capacity. The water is lifted 250 feet into two reservoirs, one 180 by 160 ft., the other 100 ft. square, at 100 ft. above the general level of the town.

Distribution is by 20 miles of cast-iron pipe of from 20 to 3 in. diameter, with 50 fire hydrants, 100 gates and 1,200 taps. There are 20 meters in use.

The town does not pay for fire hydrants. Service pipes are of wrought iron.

A portion of Phillipsburg, N. J., on the opposite side of the Delaware River, is also supplied by this company.

The population of Easton was 11,924 and of Phillipsburg 7,109 in 1880. The daily consumption in 1881 was 1,000,000 gallons.

The capital stock of the company is $200,000. The works have cost $300,000. The bonded debt is $10,000, at 6 per cent. interest. The expenses in 1881 were $10,000, and the receipts $23,500.

John Maxwell is president of the company.

CCCCXIII.—BOWLING GREEN.

Bowling Green, Kentucky, in lat. 37° N., long. 86° 25′ W., at the head of navigation at Barren River, is in a basin surrounded by hills at a distance of 5 to 8 miles. The surface rock is limestone, but the river rises in a sand-stone region and the water contains little lime. Much of the drainage of the valley flows off through caverns in the subsoil, which is a heavy, red clay.

Settled in 1787, it was incorporated as a town in 1797.

Water-works were built by the town in 1868, after plans of Charles H. Hermany, C. E. Taking the water from the river and lifting it 287 ft. by a steam pump with vertical cylinder of 9 in. bore and 30 in. stroke, into a reservoir of about 1,000,000 gallons capacity.

Distribution is by 6 miles of cast-iron pipe of from 8 to 2 in. diameter, with 100 fire hydrants and 500 taps. Lead and galvanized iron service-pipes are used.

The population in 1880 was 4,895 and the daily consumption 200,000 gallons.

The works have cost $100,000. The bonded debt is $85,000, at 6 per cent. interest.

The expenses in 1881 were $4,000, and the receipts $7,000.

The works are managed by a board of Commissioners. James Witherson is the Superintendent.

CCCCXIV.—SPRINGFIELD, ILL.

Springfield, Illinois, in lat. 39° 48′ N., long. 89° 33′ W., is on a prairie, 5 miles from the Sangamon River.

Settled in 1822, it was made the State capital in 1837, and incorporated as a city in 1840.

Water-works were built by the city in 1866, taking the supply from the Sangamon River. A conduit 80 ft. long conducts the water from the river to a pump well, whence it is pumped into a reservoir of 4,000,000 gallons capacity. There is also a stand pipe 3 ft. in diameter and 70 ft. high. There was at first an Earnshaw engine, which in 1876 was replaced by a Worthington duplex engine of 3,000,000 gallons daily capacity. In 1877 the reservoir was cleared out, and 1,300 cubic yards of sediment removed from its bottom.

Distribution is by 19½ miles of cast-iron pipe of from 15 to 4 in. diameter, with 91 fire hydrants, 180 gates and 753 taps. There are 31 meters in use.

The population in 1880 was 19,746. The daily consumption and the average number of taps in use for five years has been as follows:

	Daily Cons gallons.	No. of taps.
1877	698,104	561
1878	800,000	588
1879	1,285,000	625
1880	1,311,513	682
1881	1,653,524	730

The works cost $450,000 which is the amount of the bonded debt at 8 per cent. interest.

The receipts in 1881 were $28,607.22, and the expenses of maintenance $17,136.07.

The works are managed by three commissioners. L. R. Brown is Secretary and Fred McCarthy superintendent.

(TO BE CONTINUED.)

ADDITIONS AND CORRECTIONS.—May 18, p. 155, *Boulder Col.* The ditch from creek to reservoir is 3 by 2 ft., and 4,500 ft. long with grade of 5.28 ft. per mile. A setting basin is made in it 6 ft. wide at bottom and 18 ft. at top and 6 ft. deep for 400 ft. The reservoir is 15 ft. deep and and holds 2,000,000 gallons. There are 6.9 miles of pipe. A good deal of water used for irrigation and gardens. The population in 1880 was 3,250 and is now 4,000. The works have cost $47,500. The bonded debt is $30,000 at 10 per cent. and $17,500 at 8 per cent. The expenses in 1881 were $1,125 and the receipts $4,750.

April 2, 1881, *Boston Map.*—The Superintendents of the several divisions are, Eastern, Ezekiel R. Jones; Western, Desmond Fitzgerald; Mystic, Hiram Cutts.

November 11, 1882, p. 388. In the corrections for Middleton, N. J., read Middleton, N. Y.

The receipt of statistics, as follows, is acknowledged with thanks: From John Maxwell, President, statistics and water rates of the water-works of Easton, Pa. From John S. Titcomb, Engineer of water-works, revised statistics and water rates of the water-works of Boulder, Col. From M. H. Crump, City Engineer, statistics of the water-works of Bowling Green, Ky. From Charles E. Goad, C. E.; list of places having water supply in British possessions in North America. From J. F. LeBaron, C. E., partial statistics of the water-works of Arlington, Mass. From A. F. Matlock, City Clerk, report for 1881 of the water-works of Steubenville, Ohio. From the City Clerk, 14th, 15th and 16th reports of the water-works of Springfield, Ill.

◆

PRICES AND WAGES.

Colonel Wright, of the Mass. State Labor Bureau, says, in his last report, that the advance in the price of the following articles as contrasted with the price of the same articles in 1878 is as follows:

Groceries have advanced in price 9.1 per cent.
Provisions have advanced in price 20.1 per cent.
Fuel has advanced in price 30.1 per cent.
Dry goods have advanced in price 9 per cent.
Boots have fallen in price 1.6 per cent.
Rents have advanced 35.1 per cent.
Board has advanced 13.7 per cent.

On all these items of expense entering into the cost of living, the average increase was 21.2 per cent.

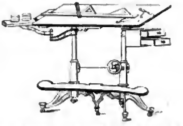
Wages have not increased in the same ratio as the necessaries of life. In some trades there has been a falling off since 1878; in the boot and shoe trade Col. Wright says wages have decreased 4.4 per cent., in cabinet making the decrease has been 1.7 per cent., carpetings 7.9 per cent., carriage making 5.4 per cent., straw goods makers' work 2.7 per cent. less than they did in 1878. But on the whole there has been an increase averaging 6.9 per cent. That is, the cost of living is 21.2 per cent more than it was in 1878, while the advance in wages has only been 6.9 per cent.—*Worcester Times.*

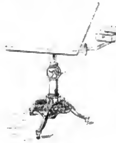
◆

BIDS FOR WATER-WORKS REMAINING UNOPENED.—We have received the following note from Irvington, N. Y., in regard to the proposals for water-works which were recently received: "Owing to a notice of an intended proceeding at law to test the legality of the election on water works by several taxpayers the bids have not been opened. They will not be until a decision is reached under the proceeding."

DRAWING TABLES.

Messrs. Keuffel & Esser, of 127 Fulton street, this city, have lately introduced a drawing table of new design, presenting many excellent characteristics. The table-top is raised or lowered to any convenient height, the mechanism for doing which consists of a rack and pinion movement. The top may be adjusted to any desired angle by a slight shifting of a knob under the front of the top, and without the necessity of changing the position or interrupting the work. A bracket arm furnished with shelf and drawers may be moved to any position on either side. By a simple device a rack can be extended over the top and can be used to temporarily increase the size of the table when using it as an easel, or for holding copies, etc.





The tables are built of the best materials, are simple in construction, and have strength and weight enough to make them firm and steady. Easels are made embodying the same principles of construction. From the accompanying engravings an idea may be obtained of the appearance and mechanism of two sizes, the larger being supported upon a double iron stand.

Particulars in regard to the "Favorite" drawing tables may be obtained from the manufacturers.

◆

IRON MARKET.

[Carnegie Bros. & Co., Limited].
(*Net f. o. b. cars, Pittsburgh*).

Angle iron.	Cts.
Equal sided, ¾ × ¾ to 1×1 to 1¼ × 1¼ in	3¼
" " 2×2 to 4×4	3¼
Unequal sided, 2 × 1½ to 4 × 6 in	3¼
Square-root angles, 1×1 to 6×6 in	3¼
Star iron, 1½ × 1½ to 4 × 4	3¼
Sash iron, ¾ × ⅝ × 3-16	3¼
Various shapes	3¼ to
Tee iron.	
1 inch and upward	3¼
Beams and Channels.	Cents per lb.
Solid wrought iron beams, 3 in. to 10½ in. by 30 ft	4
12 in. by 30 ft	4
15 in. by 30 ft	4
Deck beams, 7 in. to 9 in. by 30 ft	4
Channel bars, 3 in. to 12 in. by 30 ft	4.2
" " 15 in. by 30 ft	4.3
Plate iron.	
Universal Mill Plates, plates not over 36 in. wide by ¼ in thick and upward	2¾

STONE MARKET.

The present cargo rates for stone delivered at New York are as follows:

Amherst freestone, in rough, per cubic ft		$1.00
Berlin freestone, in rough		1.00
Berea " "	$0.85@	0.90
Brown stone, Portland, Conn	1.50@	2.00
" " Belleville, N. J.	1.25@	1.75
Granite, rough	0.75@	1.00
Dorchester (N. B.) stone, rough, per ft.		1.00
BLUE STONE.		
Rubbed hearth, 10 ft. or under		20c.
" " 20 " " "		30c.
" " 30 " " "		45c.
" " 40 " " "		[illegible]
" sills, imported		29c.
" " domestic		35c.
Sills and lintels		17c.
" " " fine quarry cut sills		30c.
Coping, 11 to 16 in. wide		18@30c.
" 20 to 28 " "		35@50c.
" 30 to 36 " "		60@75c.
Steps, 8 in		55c.
" 7 "		40c.
" 6 "		25c.
" door, per inch wide		02c.
Platforms, promiscuous, 4 in		32c.
SLATE.		
Purple roofing slate per square	$7.00@	$8.00
Green slate	7.00@	8.00
Red slate	15.00@	—
Black " Pennsylvania	4.75@	5.25

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR...............ASSOCIATE EDITOR.

SATURDAY, NOVEMBER 25, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to Geo. H. Frost.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.25	1.50
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
Journal of the Franklin Institute	4.00	5.00
Van Nostrand's Magazine	4.00	5.00
North American Review	4.00	5.00
Sanitary Engineer	2.75	3.00
Railroad Gazette (new subs.)	3.50	4.20
" " (renewals)	3.90	4.20
American Architect	5.00	6.00
Scientific American	2.65	3.20

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do this we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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INTERESTED parties will please note the new advertisement published in this issue of the city of Nashville, Tenn., for proposals for pumping engines. In order to secure a larger representation of engine builders, the time for receiving proposals is extended to Dec. 11 ensuing, and additional engines are also called for. It is to be hoped that a very full and complete representation will be the result of the increase of time allowed.

ON THE EDUCATION OF ENGINEERS.

On another page will be found an article from the editorial columns of the *Railroad Gazette* concerning the education of civil engineers, which presents in a very clear and forcible manner the claims of practical training in actual business life as opposed to that acquired at technical schools. While entirely agreeing with our contemporary as to the value of the discipline of manual labor, the importance of actual practical experience, and the absolute necessity of working one's way up the ladder by beginning at the lowest steps, we yet feel that the main conclusion reached is not in all respects that which should govern a young man who is desirous of attaining success in some branch of civil engineering. This main conclusion concisely stated is about as follows: A young man who wishes to earn his livelihood in civil engineering, and ultimately gain a competence thereby, should not take a course of study in a technical institute or college, but should plunge into practice as soon as possible after having studied algebra, geometry, trigonometry, and acquired some knowledge of physics and mechanical drawing.

Now these branches of mathematics, together with the physics, are usually taught in most high schools and academies to pupils of sixteen or seventeen years, so a lad of that age, after spending a little time at drawing, would, under the plan proposed, enter at once upon the actual work of life as axeman or rodman on a surveying party, or as an apprentice in a locomotive shop. Here he is supposed, of course, to exert all his energies to learn thoroughly the work he is set to do, and to earn his promotion up the rounds of the ladder, never confining himself closely to his chosen specialty until he acquires reputation and distinction therein.

The lad who takes a course of technical study, likewise leaves the high school at the age of sixteen or seventeen, spends a year or two in preparation and enters upon that course at the age, say, of eighteen, and at the end of the four years of study graduates, aged twenty-two. Then he begins as rodman at the foot of the ladder and bends all his energies to work his way up. In practical experience and in ability to command wages he is five years behind the other lad. Now we claim that when these typical young men have attained the age of thirty, he who has taken the course of college training will not only have attained an equal degree of success with the other, but on the average will have far outstripped him in the race.

Our contemporary selects the ellipse as a curve whose ordinates and abscissas, measured from an origin at one end of the major axis, represent the relation between education and its relative usefulness in life. At first the curve rises perpendicularly, showing the beginnings of the education to be of great value, then its ordinates increase with less rapidity until the curve becomes horizontal and then begins to descend, showing that much education may diminish the chances of success. This happy illustration may indeed represent the facts if the word education be taken to mean book knowledge only, but such cannot be the case if it be taken in its true signification. To educate, says Webster, comes from *e*, out, and *ducere*, to lead, and signifies to bring up a child, to lead out and train the mental powers, to form the character, and to prepare and fit for business. Viewing education as a drawing out and training of the powers of the mind, we must regard the curve as ever ascending, not uniformly indeed, but perhaps after the manner of a parabola. And this view of the meaning of that word is, we think, the element that has given life to and won success for the new scientific methods of education and training. As a prominent educator once tersely expressed it, the aim of education is to teach a boy how to think.

When a lad of eighteen enters upon a course of study of four years in civil engineering, he has, or should have, the ability to use his own language with reasonable correctness, a fair knowledge of history of his own country, a good command of arithmetical processes, and an acquaintance with the elements of algebra and geometry. He ought to be in good health, have some degree of ingenuity, and be possessed with the determintion to succeed in all his undertakings. Very desirable also is it that he should have had a practical acquaintance with some of the forces of nature which he aspires to control, such an acquaintance, for instance, as the carpenter's apprentice gains by his axe and chisel. A reasonable amount of such manual labor will strengthen his growing muscles, expand his lungs, and lay the foundation for habits of activity. Much study is a weariness to the flesh, and particularly so for the young. Although eighteen is a very usual age to enter college, it would be far more profitable in most cases to wait a year or two longer, until the body has acquired greater strength and the mind greater capacity. For the years between fifteen and nineteen we can think of no better plan for a lad than the old-fashioned one of four month's schooling in the winter and eight month's work and play in the summer. During these early years also, the eye and the hand should be trained by practice in free hand drawing.

Let us now consider how the four years' course of education in civil engineering is spent, and what its effect is in drawing out and developing the powers of the young man.

The study of mathematics is continued, and embraces the subjects of geometry, algebra, trigonometry, descriptive geometry, co-ordinate geometry, and the calculus. There are courses in physics and chemistry. The study of the French and German languages is usually required, and training in the use of English is not neglected. There is a course in drawing beginning with the elements of projection, and including map drawing, perspective, machine and architectural drawing, and plans of structures. There is a course in surveying, embracing land surveying, levelling, triangulation and topography, railroad location, hydrography and geodesy. There are courses in the subjects of the strength of materials, the details of construction, the strains on roofs and bridges, the steam engine, the machinery for lifting and transporting, in hydraulics and in practical astronomy. There is also usually instruction given in metallurgy, mineralogy or geology.

These subjects are not taught by a single teacher but by a dozen or more, each of whom is, or ought to be, a specialist in his special department. He who teaches the surveying should have been for many years engaged in the actual practice of that art and have had charge of parties or important field work. He who teaches the details of construction should have actually built dams and abutments and bridges, and has shown himself competent to build them strong and cheap. In our best technical schools such teachers are, we think, generally selected, when it is possible to obtain them for the limited pay offered. The new scientific education, in fact, as distinguished from the old classical one of fifty years ago, has largely attained its great success through this careful selection of the teacher.

Under such instructors it would be expected that the methods of training would be largely practical, and this is found to be the case. Books of course are used, for they embody the record of the experience of all the ages of which we are the heirs, but the teacher should be independent of them, his function being to train the young men to think, and not, as in the old method, to simply hear the lessons recited. All that is read in the books receives full illustration in the practical work. In physics each student demonstrates in the laboratory the truth of the laws of falling bodies, of latent heat, and of the equivalence of motion and energy. In chemistry he learns about oxygen and chlorine by actually manufacturing these gases. In surveying he handles all the instruments in the field and takes all the notes necessary for the construction of his maps and profiles. And all these operations are so arranged that the young man sees and understands the reason why they are undertaken. When, for instance, he takes his cross sections on the located railroad line he clearly sees the relation of the data thus obtained to a particular problem in his "geometry of earthworks." Or, when he makes his plans for a structure having columns, beams and rods, he is able to compute their proper sizes and shapes, or justify his selection of them by reference to good engineering practice. In short, the study and work is so arranged as to teach him to think for himself, to struggle with and conquer his problem, while at the same time this thinking and struggling is done mostly with those subjects upon which he intends to spend his future years.

The advantages of an education such as just described are many, and its disadvantages are few. The main advantage is the training which has developed the mind and character, and which renders the young man capable of exercising intelligent thought in whatever business he may undertake. The special information concerning engineering subjects acquired in such a course we consider to be of far less value than this general training. What he learns about surveying or drawing, the subjects with which he becomes most practically familiar, is not sufficient to enable him to take hold of any responsible work and execute it satisfactorily. He may be a good draftsman and a fair land surveyor, yet before he can be trusted far his judgment must be developed by the experience of actual business life. But the education that has taught him how to think will enable him to make rapid progress. The great field of science that has been opened to him by the study of astronomy, physics and geology will ever prove a pleasurable one in which he may roam during his hours of leisure, while his drill in the modern languages will have introduced him to the world of literature. His education has been broad, and this is well, for he who would build high must first build broad.

Viewed from a purely financial point of view, we think it could be shown, if statistics were obtainable, that a young man of good health and fair mental capacity, who takes such a course of study and graduates at the age of twenty-two, attains by the time he is thirty, a greater degree of success than he who plunges early into practice and follows closely some special branch. If, for instance, a census could be taken of all the young men of the age of thirty who are in charge of parties on railroad location or construction, it would be found that those who graduated from technical schools were receiving the highest salaries and had the best prospects for promotion, and further, we feel confident that in number they would far outrank the others. This cannot be said of men of fifty, for thirty years ago, when they were young, technical schools were scarcely known. To argue that because these older engineers have attained reputation and success without the advantages of scientific education the young men of to-day can do so likewise, is certainly fallacious, for the conditions in the two cases are far different.

An inspection of the lists of graduates given in some of the catalogues of technical institutes shows that young men who have been six years out of the school, in general, hold responsible and lucrative positions. On graduating they began at the bottom of the ladder with low pay, but they have rapidly mounted the steps, passing and often leaving far behind those who began the ascent when five years younger. In fact we know of no profession where the graduate advances so rapidly as in civil engineering. A young doctor finds it hard to obtain patients even when he furnishes both services and medicine gratis. A young lawyer is glad to take cases where he receives nothing if he loses, and almost nothing if he wins. But the young civil engineer earns at once as rodman or draftsman fifty dollars a month, and usually double or triple that amount after a very few years of practice.

The indications are, that technical education, as a qualification for technical pursuits, will grow every year more and more important, until finally it will become, as it is now in Germany, indispensible. Already some railroads hire for their field parties and drafting offices almost no others than technical graduates. They do this because they find it pays. A young man who is trained how to think is of more value to them at higher wages than one who does his work by rule of thumb at lower wages. He does more work in a day and does it better.

And when we look at the question from other points of view than the financial, everybody will agree that the young man of education has the advantage. The locating engineer, for example, does his work with a more cheerful mind, if he knows something about the rocks of the country through which he travels. He has an interest in the progress of science in general, as well as in that of his own specialty. When the panic comes that stops his work and his pay, he is not so bound to his trade that he cannot try his hand at something else. In such times, too, he feels at liberty to ask the alumni of his institution to assist in securing him employment. This may, perhaps, seem a trivial matter, but as a rule mens' lives are largely controlled by circumstances, while those who are able to control circumstances are few; and many a college man will testify to encouragement received from his brother alumni in times of commercial depression, encouragement without which his life might have been very different.

There is one other point, suggested by the remarks made, two weeks ago, by Herbert Spencer, concerning overwork and grey hairs, that should receive the careful attention of parents who are puzzled to know whether to give their boys a technical education or put them at once into practical work. Much of course depends on the boys, but if they have any liking for study, we say by all means let them continue at it. In these days of hurrying business rush and overwork, let us keep the young men out of the world as long as possible. Let the days of their youth be spent in academic halls, where the worry of business is unknown. Let the selection of their special branches of engineering labor be deferred until they are qualified by age and experience to select. Overwork and grey hairs come soon enough to men even when life is begun at twenty-two, and by commencing younger nothing whatever seems to be gained, but rather much seems to be lost.

To conclude: A young man who wishes to attain success and happiness in the occupation of a civil engineer ought to begin by obtaining a sound technical education.

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CIVIL ENGINEERS' EMPLOYMENT BUREAU.

NEW YORK CITY, Nov. 18, 1882.

EDITOR ENGINEERING NEWS:

Do you know where I would be most likely to find work at railroad construction? I've hunted the city pretty well and have not been successful.

Last winter you found me work in Connecticut, and for it I felt very thankful.

I some time ago came off of the N. Y. C. & St. Louis R.R.; there I was running ballast stakes, etc. I have done more leveling than transit work, but have done all kinds of division work. Would like to get with a good man, where I could be advanced if worthy.

Why is not a place to be found in the city where a book could be kept, giving addresses and ability of engineers, etc.; also, at the same place, a list of work and the requirements, so a man need only to apply and know his fate without running around so much?

Railroad work especially needs such a department, as the work is sometimes short, and a forced idleness is the result until work can be found. All would be willing to pay for the trouble and would appreciate such an accommodation. Respectfully, F. M.

The above is but one of many similar requests of which we are in almost daily receipt. We heartily wish we could secure situations, more or less satisfactory, for them all, since they represent the willingness of a class to work if only work can be had. We have not met with many drones in the engineering profession, and whenever our assistance has been solicited to aid in finding situations we have made it our business to do the best we could for applicants. This service is, however, very insignificant, as in every office where engineers may be needed there is usually a more or less lengthy list of applications always on file. Some years ago we started an agency to meet this want of the profession; we received letters and testimonials from a considerable list of engineers, who, in the then complete stagnation of railroad building, and impecunious condition of municipalities, were out of employment. We had applications and they were usually of the following fashion: A chief engineer in Iowa would telegraph for a transitman and leveler; pay, $75.00 and found; wanted inside of two or three days. Nothing was said about transportation, how long the engineers would be wanted, and nothing about waiting till the parties could be found.

This is a pretty big country to get over in a day or two, and civil engineers are not usually kept "on tap" to be supplied at a moment's notice.

We would overhaul our statistics, and after laying aside a large and always augmenting list of "just graduated" who were ready to go anywhere at any price, but whom we could not well afford to indorse as "experienced engineers," we would select the most reliable man who was nearest the applicant, telegraph him the matter and leave him to do the rest. It always failed, and the only satisfaction we had was in paying telegraph charges. No sensible man would "pull up stakes" and travel, at his own expense and risk, across two or three States for the small consideration offered, and the contingency of not suiting, and so being left very much worse than before he started. Neither did we wish to be party to any such ventures. We sent an engineer from Boston to Pittsburgh to fill a situation: all parties were first-class but it wasn't long before the Boston man was back at "The Hub," we sent another from near Philadelphia to Buffalo, but it resulted in a similar retrograde movement; we got two or three into situations in which they are still, after nearly three years' holding, to the satisfaction of all concerned, we presume. With the return of good times, the demand for engineers for a while overtaxed the supply; there is now a falling off in railway building, and with it comes a large supply of unemployed engineers. A considerable number of these have really no claim to be called "civil engineers," and both themselves and the profession will be benefited by their turning their brain and muscle to other branches of business. There is another large class who will have to accept the situation, and take their enforced idleness as philosophically as possible; there are others who, having large experience, ought to be able to find professional employment all the time, or very nearly so. There is still another and increasing class of engineers, whom we wish to stimulate into opening offices for themselves, as specialists in one or more branches of the profession. In this great and rapidly-developing country there will always be a demand for engineering talent, and the men who become known and recognized as specialists will find remunerative employment. There should be an unremitting effort on the part of reputable engineers to maintain remunerative prices for their services, and as rapidly as possible introduce the practice of requiring payment for opinions or advice, which now seem to be considered by the public as worthless although eagerly solicited. The timely advice of an engineering expert will save to a client much expense and annoyance in many ways, and it ought not to be reckoned as gratuitous, while lawyers and doctors claim a fee for much less valuable services.

With regard to a record book, we would keep one if we thought it would be of any value. There is one now at the rooms of the American Society of Civil Engineers, for the benefit of members. How much it is utilized we do not know. Until we can devise something better, we can offer only the alternative of advertising in ENGINEERING NEWS. If this were generally adopted it would constitute a "record book," and it would, after a time, be consulted as such. Our charge for inserting such cards is only a nominal one of twenty-five cents each insertion; for parties who advertise for engineers we charge fifty cents. If only an occasional "Want" is advertised, we frankly say that the money is wasted; if it becomes general, it will soon become known among parties seeking engineers, and it would enable us to keep such a record well advertised before the proper parties. These printed cards would be pasted into a book, which would gradually assume importance as a "record book," which would fulfill the requirements of our correspondent.

There is no advertising so valuable as that of a respectable newspaper; the business of the world now is divided into specialties, each with its recognized newspaper exponents. The more such a newspaper is patronized by the class whose interests it advocates, the more it is sought after by searchers for that particular information, and just in the same proportion it accrues to the interest of its patrons. We repeat what we have already said: a newspaper to live must be useful, and the more useful it becomes the more valuable it is to the publisher and his patrons. Use, then, your special journal to advertise your business wants, great and small, and you will soon discover how keen is the public to find out where to go to save itself trouble and expense.

PERSONAL.

A despatch from Louisville, dated Nov. 21, states that **Gen. F. De Funiak**, general manager of the Louisville and Nashville railway, has sent in his resignation to take effect Jan. 1. It was further stated that he had resigned in order to devote his entire attention to the Pensacola and Florida railroad, of which he will become president.

J. D. Cook, hydraulic engineer, of Toledo, O., who is now Consulting Engineer for the new water supply at Nashville, Tenn., is in Galveston, Tex., engaged in examinations preparatory to devising a system of water-works for that city. Mr. Cook is also engaged by the city of New Orleans to make designs and estimate cost of a thorough system of subsidence of Mississippi River water for that city.

Rudolph Hering, sanitary engineer, has changed his office from Philadelphia to New York, and all correspondence should hereafter be addressed to him at Room 18 Tribune Building. Mr. **Hering**'s first season, "on his own account," as a sanitary engineer has been an eminently successful one. He has been consulted on the sanitary condition of Cleveland, O., Racine and Appleton, Wis., Waterbury, Conn., Roanoke, Va., and Binghamton, N. Y., for which cities his reports and plans of sewerage have been adopted. He has also been called as consulting engineer at Sea Bright, N. J., and in several minor cases of sewerage and house drainage.

D. McN. Stauffer, M. A. Soc. C. E., formerly assistant engineer in the Philadelphia Water Department, afterward engineer for the contractor of the Dorchester Bay tunnel, of the Boston Improved Sewerage, late Principal Assistant Engineer "Bound Brook Route," Philadelphia to New York, has gone into business on his own account, with office at No. 18 Tribune Building, this city. The class of engineering work which he solicits is given in our advertising columns; his abilities as an engineer are too well known to need any further endorsement here. Mr. **Stauffer** has just returned from Portsmouth, Va., for which city he is preparing plans for water-works.

CORRESPONDENCE.

BAD TASTE IN WATER.

New Albany Water-Works Company,
New Albany, Ind., Nov. 18, 1882.

Editor Engineering News:

I have seen, a number of times, discussions on the causes of the bad taste of water, which is palatable at its source. I have, between the reservoir and the valve on outside of reservoir, a small hydrant for the use of the keeper of the reservoir. The water from this hydrant, when the water in the pipes was shut off for two or three days in summer time, would always smell as if full of dead fish. I had soon after occasion to break the pipe, and found it covered with a network of brownish moss of just that same smell, only more so; while in the distributing mains I never found the moss; the pressure being 75 to 85 lbs., is evidently too great for vegetation. This only as an opinion for what it is worth. Yours truly,

Frank Schefold, Civil Eng. and Supt.

IMPROVEMENT OF THE UPPER MISSISSIPPI.

Abstract of all proposals received and opened Nov. 7, 1882, by Major A. Mackenzie, Corps of Engineers, U S. A., Rock Island, Ill., for building brush and stone dams and shore protections in vicinity of Louisiana, Mo.

Names of Bidders.	Residence.	Brush.	Stone.
		Per cu. yd	Per cu. yd.
H. S. Brown	Quincy, Ill	1.25	1.78
Patterson Bros.	Keokuk, Ia.	.85	1.55
Frents & Co.	St. Louis	.88	1.58
A. J. Whitney	Keokuk, Ia.	1.20	1.75

Abstract of proposals received and opened by Major A. Mackenzie, Corps of Engineers, U. S. A., Rock Island, Ill., Nov. 7, 1882, for building stone and brush revetment, below Quincy, Ill.

Names of Bidders.	Residence.	Brush.	Stone.
		Per cu. yd.	Per cu. yd.
H. S. Brown	Quincy, Ill.	.90	1.40
Patterson Bros.	Keokuk, Ia.	.90	1.80
A. J. Whitney	Keokuk, Ia.	1.00	1.65

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting on the evening of the 15th inst., Vice-President Paine presided, and in the absence of Secretary Bogart, Mr. J. J. R. Croes officiated. Answers to the following circular letter had been received and abstracted by the secretary, and in that form were read by the acting secretary:

Dear Sir: We are informed that there is included in the Army Appropriation Bill as recently passed by Congress and approved by the President a section making an appropriation of $10,000 for the use of the testing machine at Watertown Arsenal, containing also the following clause:

"The Chief of Ordnance shall give attention to such programme of tests as may be submitted by the American Society of Civil Engineers, and the record of such tests shall be furnished said society, to be by them published at their own expense."

The Board of Direction of this society desires to secure the best advice in reference to the action expedient to be taken under these circumstances, and has requested the President and Secretary to correspond with a number of those interested in the investigation, production and use of structural materials and obtain their views.

We, therefore, beg that you will advise us, first, how, in your judgment, can a programme of desirable tests of structural materials best be prepared? Second, give us such suggestions as may occur to you as to the general character and details of such a programme.

We may add that it is proposed to ask the cooperation of the Institute of Mining Engineers and the Society of Mechanical Engineers in this matter. An early reply will greatly oblige

Yours very truly,
President A. S. C. E.
Secretary A. S. C. E.

The following were elected:

FOR MEMBERS.

Augustus Jesse Bowie, Jr., Civil Engineer, San Francisco, Cal.

Collinson Pierrepont Edwards Burgwyn, U. S. Assistant Engineer, Richmond, Va.

Edgar Sheldon Cary, Res. Engineer New York, Ontario & Western R. R., Newburgh, N. Y.

Frank Hudson Clement, Div. Engineer South Pennsylvania R. R., Everett, Pa.

Frederick Y. Dabney, Chief Engineer and Superintendent Vicksburg, Shreveport & Pacific R.R., Monroe, La.

Edward Prince (elected Junior, Feb. 6, 1878), Superintendent and Constructing Engineer Water-Works, Quincy, Ill.

George M. Rusling, Engineer for Contractors New York, West Shore & Buffalo R. R., Newburgh, N. Y.

Edward Yorke, Chief Engineer Pacific Line, Mexican Central Railway, Guadalajara, Mexico.

Nov. 1, 1882.

The Nominating Committee has presented through Messrs. Fink and Gottlieb of the committee the following names of members selected as candidates for officers of the society for the year 1883: For President, Charles Paine; Vice-Presidents, Wm. H. Paine and Henry Flad; Secretary and Librarian, John Bogart; Treasurer, J. J. R. Croes. Directors: George S. Greene, Jr., Joseph P. Davis, Wm. Metcalf, Wm. E. Merrill, Wm. G. Hamilton.

WESTERN SOCIETY OF ENGINEERS.

The 157th meeting was held on Tuesday, Nov. 7, 1882, at 4 P. M., Vice-President Booth in the chair.

The minutes of the 155th meeting were read by the Secretary; also a letter from Mr. Willard S. Pope resigning the office of President on account of his going abroad for some time.

Adjourned.

No business was transacted at the 156th meeting. L. P. Morehouse, Secretary.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Analysis of Artesian Well Water for Madison, Wis.—Prof. W. W. Daniells, chief chemist at the State university, has just completed an analysis of the water from the city artesian well, which is to supply the Madison water-works. The analysis is as follows, the composition being expressed in grains per United States gallon—a comparative statement of the composition of the Bethesda spring at Waukesha being also given:

	City well.	Bethesda.
Potassium sulphate	0.237	0.454
Sodium sulphate	0.291	0.342
Sodium phosphate	trace	trace
Bi-carbonate of soda	1.004	1.256
Bi-carbonate of lime	15.234	17.022
Bi carbonate of magnesia	12.984	12.398
Bi-carbonate of iron	0.214	0.042
Sesqui-oxide of aluminum	trace	0.122
Silica	0.414	0.741
Sodium chloride	0.292	1.100
Organic matter	.. ...	1.083
Total solid contents per gallon	30.755	35.710

The relative hardness of the city artesian well water and the water of the lakes is as follows: Lake water, 10.2; city well water, 7.8. It will therefore be seen that the lake water is forty per cent. harder than the city well water. Experiments were made regarding the effect of well water on metal pipe: After standing thirty days in contact with a clean piece of lead there was no indication of lead in the water; galvanized iron pipe under precisely similar conditions gave a trace of zinc in the solution. From this it will be seen that, unlike the water in many cities, ours does not affect lead pipe and therefore no harmful result can happen from the use of that metal; on the other hand, galvanized iron might produce slightly deleterious effects.—*Wisconsin State Journal.*

A Franchise for the Danville water-works of Danville, Ill., has been granted to a company represented by Carrol E. Gray.

One mile of pipe has already been laid for the new Iowa City, Ia., water-works.

Upward of thirteen miles of water-pipes have been laid in Detroit this season.

Cheap Gas.—A writer to the Richmond (Va.) *Despatch* says: It was my fortune to reside in Belfast, Ireland, for nearly seven years. I was a house-keeper and gas-consumer while in Belfast. The gas-works in that town are owned by the corporation, and all the coal used in the manufacture of the gas is brought across the channel from England, Scotland or Wales. Yet when I left Belfast the price to consumers was 3 9 sterling, or ninety-one cents per thousand feet of our money. The works in Belfast were originally built and put in operation by a London company, but a few years ago were purchased from them and are now owned by the corporation.

Water-Works Voted for in Stoneham, Mass.—On the 18th the vote by ballot was nearly three to one in favor of accepting the Quannapowitt Company's proposition to supply the town with water. This company is of Wakefield, and proposes to lay mains and pipes in both Wakefield and Stoneham, the supply lakes being in the former town. William R. Stevens, Esq., District Attorney, is the Chairman of the Stoneham Committee. It is understood that the work is to be commenced at once.

The contract for the Sanford, Fla., water-works has been signed and delivered.

The Boston Water-Supply.—The commission appointed to investigate the causes of the impurities existing in the Cochituate water supply visited Whitehall Pond, which indirectly furnishes a portion of the Sudbury River supply, to ascertain if any of the trouble comes from that source. The commission, before it makes its report, will examine every source of supply with a view of definitely settling the causes which have given rise to so many complaints.

Red Bank to Have a Water Supply at Last.—Several of the New York fire insurance companies have ordered their agents at Red Bank, N. J., to cancel all policies on buildings in the thickly settled portions of the town since the late fire. The Board of Commissioners of the town signed a contract with the Shrewsbury City Water Supply Company, a corporation that only existed on paper, March 9, 1882, by which the incorporators of the Company were to erect water-works and supply the town with water inside of eight months. This time having expired without any work being done by the company a new one has been organized by the capitalists of the town. The incorporators are State Senator Applegate, Judge John L. Wheeler, Anthony Reckless, Treasurer of the New York & Long Branch Railroad Company; Isaac B. Edwards, cashier of the Second National Bank; Dr. Robert R. Conover, Edward E. Roberts and J. A. Throckmorton. The new corporation has a capital of $100,000 and will be known as the Shrewsbury Water Company. Robert C. Bacot, the engineer of the State Board of Riperian Commissioners, is making the surveys of a number of streams of water near the town, and the new works will be erected at once.

ELECTRICITY.

UNDERGROUND TELEGRAPH SYSTEM.—PHILADELPHIA, Nov. 21.—An exhibition of an underground telegraph system was given here to-night in the presence of many electricians, business men, and members of the city Government. By this system the main trunk line is built large enough to carry several thousand wires, and also leave a passageway for a man to pass through to make repairs or lay new lines. From this main conduit, at the intersection of cross streets, small branches extend on each side under the gutter stones, while the houses are reached by boring through the solid earth and foundations. The test to-night of the electric light, Morse telegraph, and telephone lines, the conducting wires of which were laid side by side in the same trench, was deemed satisfactory, the induction between the wires being imperceptible.

The Wisconsin Telephone Company now controls one thousand miles of wire in the state.

RIVERS AND HARBORS.

THE MISSISSIPPI RIVER INVESTIGATION.—MEMPHIS, Tenn., Nov. 16.—General Q. A. Gillmore, President of the Mississippi River Commission, has addressed a letter to Mr. Burrows, Chairman of the Congressional Committee investigating the Mississippi River, saying that the present plan of the commission is to control the flow of the river by creating for it, within its present bed, a narrower conduit so arranged that the water shall be constrained to flow over the same path at all stages, and by its greater velocity and concentration of effort recover at the bottom the equivalent of the waterway taken from the sides.

RAILROADS.

THE ARKANSAS division of the St. Louis and San Francisco railroad is open for business to Von Buren, on the Arkansas River, opposite Fort Smith, 413 miles from St. Louis.

E. R. TRAFFORD, Civil Engineer of the South Florida Railroad, will commence the survey of the line from Kissimmee to Charlotte Harbor, about the 1st of December, with a view to its final location and extensions.

NEW LINE.—A dispatch from Pittsburgh to a New York paper gives as one bit of interesting fresh news that not only is a line from Columbus to New-Vienna, on the Marietta & Cincinnati, contemplated, but the money is ready, the pool formed, and actual work is about to begin.

CHEAP RIDING.—The distance from St. Paul to Chicago is 409 miles, and competition has reduced the passenger rate to twenty-five cents.

THE N. W. R. R. WAR.—As there seems to be some confusion of ideas about the exact cause of the present Northwestern row, it may be as well to explain its nature. The Chicago, Milwaukee and St. Paul Company has a main line from Chicago to St. Paul. The Chicago & Northwestern has for some time also run into St. Paul over the Chicago, St. Paul, Minneapolis & Omaha. A pool arrangement has hitherto existed between these two lines, but the Chicago, Rock Island & Pacific people, annoyed at the inroads which have been made into their territory by the other roads, resolved to retaliate, and by means of the Burlington & Cedar Rapids and the Minneapolis & St. Louis roads have acquired a direct route of their own between St. Paul and Chicago. Having done so, they demanded that they should be admitted into the pool, and upon the refusal of the other road they immediately began to cut passenger rates, so that any person traveling from St. Paul to Chicago need now pay only 25 cents instead of the former fare of $13.

RAILROAD INTO THE ADIRONDACKS.—Two wealthy New England lumbermen propose spending $400,000 in building a railway into the Adirondack wilderness.

THE Austrian Ministry of Communications has granted to the Sudbahn or Southern Railroad Company the concession for the construction of an electric railway to run from Modling to Bruhl in the suburbs of Vienna. This will be the first electric line in the Austrian capital. It will be about three kilometers, or two miles, in length, and will run from the Modling Railway Station on the Southern Line through the village of Modling, and thence through Klausen to Volderbruhl. It will be a single line. The gauge is one meter, and the gradients are not to exceed 15 in the 100, while the minimum radius must not be smaller than 30 meters. The maximum speed allowed by the terms of the concession is 20 kilometers, or about 12½ miles an hour.

CANALS.

THE PANAMA CANAL.—A recent despatch from Aspinwall says: "It is reported that the canal company recently let a large number of contracts. Two of the most important are for cuttings. The first provides for a cut of seven miles on the Panama side, and includes that section extending from the Boca del Rio Grande—about a mile west of the city of Panama—to near Paraiso, on the line of the Panama Railroad. This cutting will be nearly all through swampy land, and the contract calls for the removal of 7,000,000 cubic meters of earth. The second is for a cut of the same distance from Culebra, on line of railroad, and was let at 52 2-10 cents per cubic meter. Canal agents have gone to Cartagena and Cauca for men. The Jamaicans are not satisfied with the pay, and many of them work a few months and then go back home."

REVIVAL OF THE CAPE COD CANAL PROJECT.—BOSTON, Nov. 21.—The proposed revival of the Cape Cod canal project has already taken definite shape under new auspices. Capt. Nathan Appleton, in behalf of the would-be corporator's case, filed an application, to be acted on by the next Legislature, for a special charter, fixing the capital at $2,000,000. In conversation today, Capt. Appleton said there would be associated with him in the enterprise Count de Lesseps and Gen. Turr, the Hungarian, well known in connection with canal construction. New York, Boston and foreign capital will supply all needed support. Capt. Appleton further asserted that Mr. Whitney, president of the old company, is in full sympathy with the new enterprise and no opposition is anticipated from any source. Capt. Appleton claims to have received a hearty endorsement of the project from Gov. Butler. He estimates the cost of the undertaking at between two and three million dollars and the necessary time for construction at three years. Concerning the financial prospects of the enterprise, its projectors calculate on transporting an annual tonnage of about 5,000,000, at a toll of five cents per ton, yielding an income of $250,000. A greater tonnage than that mentioned, it is stated, now goes around the Cape. It is further announced that the work will be undertaken in earnest as soon as the necessary legislative sanction is obtained, probably in the early spring.

CONTRACTS LET.

WATER-WORKS CONTRACTS LET.—A special meeting of the Gloucester City, N. J., Council was held Nov. 22, for the purpose of awarding the contract for the construction of the proposed new water-works. The engineer employed has surveyed ground near Mount Ephraim, where the works will be erected. There is located there a number of natural springs, and this water is to be pumped to the city, a few miles distant. The contracts were awarded as follows: Furnishing and constructing the pipe system, Gloucester City Iron Works, at $57,377.39; stand-pipe, by the same company, $6,000; construction of dam, etc., John Esebbock, of Philadelphia, $7,141; Corliss engine, Wetherill & Co., of Chester, $14,550; erection of engine house and base of tower, Thomas Leaming, of Philadelphia, $6,112; furnishing fire protection, H. P. B. Birkinbine, of Philadelphia, $2,500; total cost, $93,680.39.

GRANITE CONTRACT LET.—The Treasury Department has awarded the contract for granite work about the approaches to the public building at Hartford, Conn., to the Mount Waldo Granite Company, of Frankfort, Me.

RAILROAD CONTRACT LET.—The *Citizen* of Jackson, Mich., states that the contract for constructing the road-bed of the Grand Trunk extension from Pontiac to Jackson has been awarded to S. C. Brooks & Co. The road, by the terms of the contract, must be in readiness for the iron in thirteen months.

BUILDING.

AN UNHEALTHY HEALTH OFFICE.—WASHINGTON, Nov. 17.—The Health Officer of the District has been informed by the Inspector of Plumbing that the building occupied for several years by the Health Office is in very bad condition, with evidence of leaking sewers, extensive soil pollution, and sickening odors. He recommends that the rules governing plumbing and house-drainage be rigidly enforced in the Health Office itself.

NEW PENSION OFFICE.—Gen. Meigs says that as soon as his plans are approved by the Secretary, he shall begin work on the new pension office in Washington immediately thereafter.

MISCELLANEOUS.

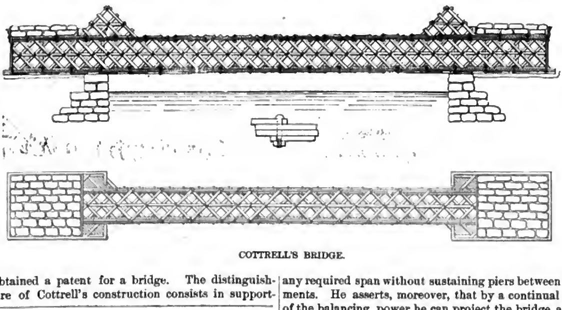
A BLAST of 6,000 pounds of powder was exploded on the Oregon & California railway. This is said to be the largest blast ever undertaken on the Pacific coast.

TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

On the 10th of November, 1841, Albert Cottrell, of Rhode Island, obtained a patent for a bridge. The distinguishing feature of Cottrell's construction consists in supporting the bridge during the process of building, as well as after completion, by the application of a balancing power comprising stone laid upon a part of each end of the bridge projecting in rear of its abutment, thus preventing a depression or sag of the bridge. The structure is given the appearance of a very flat segment or arch. The inventor states that, by his construction, a bridge may be erected of any required span without sustaining piers between the abutments. He asserts, moreover, that by a continual addition of the balancing power he can project the bridge across the



COTTRELL'S BRIDGE.

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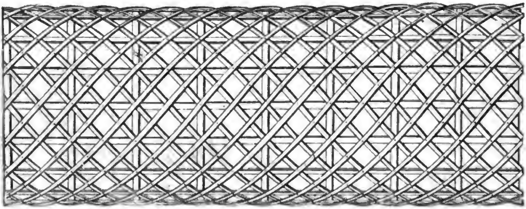
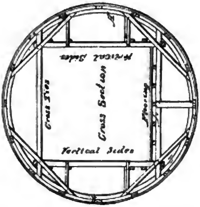
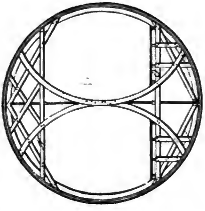
* Copyright, 1882.

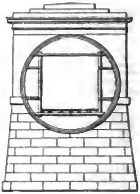
stream without the use of centering. When continued a sufficient length, the opposite or projected end of the bridge may be lowered upon the abutment on the other side of the river, by removing a suitable quantity of the balancing material, and when this end is properly weighted, the operation is completed. The "lattice" system of truss is employed, with some modifications, shown by the drawings.



ROGER'S BRIDGE.
SECTION SHEWING RIBS AND STRING-PIECES WITH THE CROSS-BAR IN WOODEN BRIDGES.





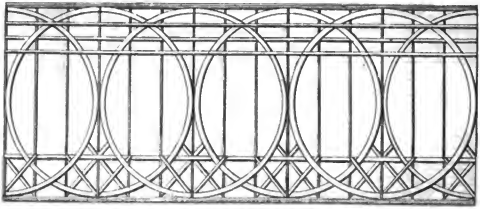


ELEVATION OF PIER ON WATERSIDE.

In the same year and date Isaiah Rogers, of New York, got up a "spiral braced cylinder bridge."

Rogers proposed to make the exterior framework of this bridge either of wood or iron, and so put together as to constitute a complete latticed bridge from end to end, the lattices being formed by spiral braces surrounding the cylinder. Within the cylinder is constructed a hollow rectangular prism which constitutes the passage-way of the bridge. The vertical sides of this road-way are formed by a series of rings united together, and to vertical studs and horizontal string-pieces by means of bolts. In bridges of a long span the road-way is to be divided into two parts by a central partition.

In bridges of iron the bars which form the circular ribs may be bent edgewise. As there is not any lateral thrust upon the piers the bridge may be laid in stone masonry or on piles. When a bridge of this kind is to have a span of unusual length one or more arched tubes may be constructed upon the same principle as that of the cylinder, and placed below the cylindrical bridge, its ends bearing against suitable abutments, and its crown-plate coming in contact with the center of the bridge on its lower side.



LONGITUDINAL SECTION IN IRON BRIDGE.

(TO BE CONTINUED.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 405.)

CCCCXV.—WHEELING.

Wheeling, West Virginia, in lat. 40° 8' N., long. 80° 47' W., on the east bank of the Ohio River, is on the bottom lands where Wheeling Creek empties into the river, and on Zanes Island in the river. It extends four miles along the river, and averages half a mile wide from the river to hills from 250 to 600 ft. high.

Settled in 1782, it was incorporated as a city in 1836. Water-works were built by the city in 1831, taking the supply from the Ohio River.

The suction pipes of the pumps are laid about 100 ft. into the river, and are perforated near the end with 1-in. holes. Two side-lever steam engines, with cylinders of 20-in. diameter and 84-in. stroke, are geared to double-acting piston pumps of 16-in. bore and 130-in. stroke, the engine making two strokes to one of the pump. In 1880 a Worthington duplex high-pressure engine of 29-in. steam and 15-in. water cylinders of 36-in. stroke was added.

The water is pumped 190 ft. into a reservoir on the hill side 150 ft. above the lowest part of the city, but 25 to 50 ft. below many residences on the hill. It is on rock, and inclosed by masonry walls. It holds 880,000 gallons. Every year from 18 to 24 in. of sediment is removed from its bottom.

Distribution is by cast-iron pipe of from 30 to 3 inches diameter. Many of the smaller pipes have become filled with sediment, and are being replaced by 6 inch pipe. It is estimated that 32½ miles of pipe are in use, with 300 fire hydrants. The number of gates and taps is unknown to anyone. Service pipes are of lead. There are no meters except 13 on hydraulic elevators, and they are not used.

The population in 1880 was 31,186. The daily consumption is estimated at 3,000,000 gallons. The cost of the works and the bonded debt are unknown. No systematic account of expenses was kept prior to 1882. The expenses and receipts for 1880 and 1881 were as follows:

	1880.		1881.	
Pumping expenses ..	$9,310.30		$14,512.81	
Salaries	5,000.00		5,000.00	
		$14,310.30		$19,512.81
Extensions	12,177.23		54,567.15	
Contingent Expenses	8,303.89		25,783.50	
Total Expenses..	$34,791.42		$99,863.46	
Receipts	33,351.89		56,022.46	

The works were formerly managed by a committee of the City Council. There is now a board of control of 3 members elected by the Council.

John Cummings was Superintendent from 1862 to 1878. James H. Riddle is the Superintendent now.

CCCCXVI.—STEUBENVILLE.

Steubenville, Ohio, in lat. 40° 25' N., long. 80° 43' W., is on high ground on the right bank of the Ohio River. Low-water mark in the river is 640¼ ft. above the sea.

A block house was built at the point in 1876, but the town was not settled until 1797. It was incorporated as a city in 1851, and extended in 1871. The town was supplied with water from springs through wooden pipes prior to 1835, in which year water-works were built by the town, taking the supply from the river and pumping it by a 40 horse-power steam pump three-quarters of a mile, through 8-in. pipe, to a reservoir holding 400,000 gallons, 193 ft. above the river. Another reservoir, holding 600,000 gallons, was afterward built. In 1867, two steam engines, each of 150 horse-power, with plunger pumps, were built by James Means & Co., and a 20-in. force main laid. Two 15-in. pipes, laid 300 ft. out on the river bed, convey the water to the pump well. The supply is taken from the river below where the city drainage enters it.

Distribution is by 18.8 miles of cast-iron pipe, of from 20 to 2-in. diameter, with 109 fire hydrants, 192 gates and 1,725 taps. Service pipes are of lead.

The population in 1880, was 12,017. The daily consumption, in 1881, was 1,300,000 gallons.

The cost of the works is not known. The bonded debt is $12,000 at 5 per cent. The expenses in 1881 were $20,473.80 for maintenance, and the receipts from water rents were $16,750.

The works are managed by three trustees. R. J. Irwin is the superintendent.

CCCCXVII.—PERU, IND.

Peru, Indiana, in lat. 40° 47' N. long. 86° 6' W., is on the Wabash River, on level ground extending back about half a mile to bluffs 90 to 100 ft. high. It was settled about 1820. Water-works were built by the city in 1879, after plans of J. D. Cook, C. E., taking the supply from the river. A 20-in. cast-iron pipe conveys the water 370 ft. from a crib in the river to two brick wells 5 ft. in diameter and 22 ft. deep, from which it is pumped by a Worthington compound duplex engine of 1,500,000 gallons daily capacity, and a Worthington high pressure engine of 1,000,000 gallons capacity, through 2,446 ft. of 12-in. pipe, to a reservoir holding 1,250,000 gallons 93 ft. above the pumps, or 116 ft. above the river. Distribution is by cast-iron pipe of from 16 to 4 in. diameter. On May 1, 1880 the date of the latest obtainable statistics, there were 11.8 miles in use, with 101 fire hydrants, 83 gates and 130 taps. It is not known what kind of service pipes are used.

The population in 1880 was 5,280 and the daily consumption 213,000 gallons.

The works cost $111,068.60. The cost of maintenance the first year was $4,872.98 and the revenue $3,844.76. The works are managed by three trustees, elected by the people.

(TO BE CONTINUED.)

ADDITIONS & CORRECTION.—Nov. 11, p. 388 and Nov. 25, p. 405, for *Middleton*, read *Middletown*.

Nov. 18, p. 399, *St. Joseph, Missouri*. L. W. Densmore, corrects the description of the topography as follows: The city lies on the Blacksnake Hills, and a strip of bottom land enclosed between them and the river, not more than 3000 ft. wide at the widest point, about ⅔ of the population residing on the hills, the highest parts of which are about 180 ft. above high water in the river. The city is intersected by two valleys, in one of which, next the reservoir, flows Blacksnake Creek, about 5 miles long. The other valley, at its debouchure from the hills, ½ of a mile from the river, has an elevation above the river of about 40 ft., but might be turned by a detour of about 1½ or two miles.

For *Clew*, Secretary, read CHEW.

The receipt of statistics as follows, is acknowledged with thanks:

From B. Walker Peterson, C. E., statistics and water-rates of the water-works of Wheeling, W. Va.

From Roger P. Atkinson, C. E., statistics of the water-works of the Western N. C. Insane Asylum, Greensboro, N. C.

From A. F. Matlack, City Clerk, statistics and water-rates of the water-works of Steubenville, Ohio.

From T. N. Bartelle, C. E., statistics of the water-works of Fort Dodge, Iowa.

From D. M. Swan, Secretary, statistics and water-rates of the water-works of Leavenworth, Kansas.

From W. E. Pettee, statistics of the water-works of Canaan, Conn., Cheshire, Mass., and Richmond Furnace, Mass.

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THE AMERICAN PUBLIC HEALTH ASSOCIATION.

To the Members of the Advisory Council of the American Public Health Association, and other Officers and Members of the Association:

GENTLEMEN: The American Public Health Association, during the ten years of its existence, has given original force and direction to much of that spirit of inquiry as to public health and State medicine in the United States, which now so largely secures public attention. Its mission for good, while still that of popularizing sanitary science and applying sanitary art, has come to demand such expert skill as can define methods with precision and present them with the supports, either of experiment, of fact, of logic or of experience. It is not now so much to insist upon certain things as necessary, as to present and enforce how best to do them. To this end we desire—

I. To arouse the present active membership to such early and specific study as will lead such as offer papers, to give us the results of their patient industry and their careful experience.

II. To induce additional members of State and city boards, who are engaged in health offices in their respective localities, to become members of the Association.

III. To outline so early the chief subjects for our next meeting at Detroit, as to give full time for careful research.

IV. To turn the attention of our membership so earnestly to the needs of a well-sustained National Health Service as shall lead each, in their respective States, to be importunate that there be no curtailment of power and resources in such direction.

To these ends, as your presiding officer for the year, I ask—

I. That the Advisory Council, and other officers, will feel themselves especially charged with the duty of recommending to the Executive Committee, members from their respective States, whose applications the committee may consider at its meeting in February, 1883. The application should state "the business or profession and special qualifications of the person so proposed," and may be sent either to the President or Secretary. Although the membership is large, it is noticeable that some of the States have a small attendance, which can be increased if members of boards of health and the local members of the Advisory Council take the matter specifically in hand.

While physicians naturally form the nucleus of such an association, it is very important that it represent the whole scope of hygiene and of sanitary art.

To this end we ask that you also select from your own State, for recommendation, such educators, engineers, plumbers, architects, chemists, or other scientists, as will aid in illustrating the applications of their specialties to the art of preserving life.

II. That persons desiring to offer papers on any special subject, early apprise us, so that the outline for the year may include such subjects as are approved by the Executive Committee.

III. That the members of the Advisory Council in each State see to it, that by honorable and direct effort their Representatives in the National Congress, are made fully acquainted with the present status of national health administration, and the reasonable provision, both as to law and appropriation, requisite for a proper defense of the national health, "*Salus populi suprema est lex.*" Such welfare not only includes health, but has its protection as a primal idea.

I will be glad to receive any suggestions tending to aid these purposes, and so promote the efficiency of the Association, and will present them to the Executive Committee at its first meeting.

(Signed) EZRA M. HUNT,
President of A. P. H. Association.

TRENTON, Nov. 15, 1882.

ENGINEERS' SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, NO 1523 CHESTNUT ST., PHILADELPHIA, PA.

Record of Regular Meeting.

November 4, 1882, Past President Frederick Graff in the chair. Twenty members present.

Mr. John Haug, in presenting the club with a copy of Lloyd's Rules for Iron Ships, stated the number and tonnage of ships built in Great Britain in 1881 as follows:

	BUILT IN 1881.			LOST IN 1881.	
	Number.	Tonnage.	Material used.	Number.	Tonnage.
Steel steamers	34	68,366	32,000 tons	1	1,536
Steel sailing vessels	3	2,167	1,500 tons		
Iron steamers..	411	590,503	300,000 tons	139	138,370
Iron sailing vessels	50	68,050	34,000 tons	52	43,936
Wooden steamers	30	1,650		18	1,704
Wooden sailing vessels......	250	16,448		821	168,579
Total	787	748,793		1,031	354,125

The principal changes in the rules for 1882 have been in water-tight bulkheads, of which more are now required in longer and larger vessels, and they are to be extended to the principal upper deck.

Vessels of extreme proportions (over 11 depths in length) have to be better strengthened in their top and bottom members, by doubling strokes, etc.

Treble riveted butt-straps are required to a greater extent, as forming stronger joints.

The rules for boilers, machinery, pumping arrangements, spare parts for machinery, etc., have been extended and improved, with a view to greater safety at sea.

As ship-building of steel is increasing, a reduction of 20 per cent. from the scantlings required for iron is permitted, giving ships so much more carrying capacity. A complete set of rules for testing all materials insures uniform quality in steel used. Steel castings, by the Siemens-Martin or Bessemer process are also now used, in place of large and expensive forgings, for sternposts, rudders, stems, etc., and they have been found strong and tough; they are less expensive than scrap-iron forgings, and the risk of bad welds and inconvenience of rough and uneven shape is avoided.

The latest circular issued by Lloyd's Register offers to fix a proper load line for each vessel, according to its style, form, etc.; thus the rules not only provide for its proper strength, but also its sea-going qualities, etc. This is of the greatest importance in view of the many disasters that have occurred from the want of those qualities.

Mr. Haug also exhibited and described drawings of his own and other valve gears.

The one patented by Mr. Haug belongs to that class in which the longitudinal and lateral motion of an eccentric or other rod are both utilized for obtaining a variable cut-off and reversing motion. In comparison with F. C. Marshall's and Joy's valve motions, which have both been extensively used, this valve motion consists of fewer parts and joints, can be more compactly arranged, and has the least amount of motion to all its parts, being thus more accessible for oiling, etc. Compared with the link motion, it is considerably simpler, has less friction (all sliding friction being replaced by bolt friction), requires less force to reverse, and will consequently throw less strain on all its members.

Mr. Charles G. Darragh read a paper entitled, "Some Notes on the Pollution of Water," in which he said:

The water supply of most of our cities, excepting perhaps Brooklyn, is affected in one or more ways, and often where large sums of money have been expended to obtain pure water, particularly in New York, Boston and Baltimore (having a gravity supply).

Water may be contaminated naturally as well as artificially.

Artificial contamination under the general head of sewage should be prevented.

Natural mineral contamination must be treated either chemically or mechanically. Natural organic contamination is produced by decaying plants, algæ and other organisms. Shallow reservoirs, tidal streams and marshes induce the growth of vegetation, which dies in the fall and allows the hot rays of the sun to kill the algæ, both of which, while decaying, produce a disagreeable taste and smell.

The water in deep reservoirs is also affected. Perfect decomposition of decaying organisms seems to be prevented in the lower strata when the temperature is lower and the air has been expelled by compression, for upon exposure to the air and motion, gas is eliminated and the offensive taste and smell dispelled.

Water in dead ends of street mains is generally in this condition.

As examples of contaimination due to shallow water, swamps, etc., we have Boston, New York, and Frankford reservoir, the latter receiving its water from the Delaware River, Philadelphia, while the deep lying strata of water in Tumbling Run dam on the Schuylkill, and Druid Hill Reservoir, Baltimore, illustrate deep water pollution. The paper also explained how, if the sewage was kept out of the Schuylkill, it would under natural condition give a purer water than the Delaware; also that the Schuylkill water from Fairmount Pool, contaminated as it is by sewage, will keep in storage reservoirs better than Delaware water taken from Lardner's Point, where there is but little sewage contamination.

The paper also suggested how collecting reservoirs should be built to abate the trouble spoken of.

HOWARD MURPHY,
Secretary and Treasurer.

Record of Regular Meeting.

November 18, 1882, President Rudolph Hering in the chair. Twenty-three members present.

Mr. Chas. W. Pusey presented a paper upon the Twin Screw Steamer "Victoria." On Tuesday, Nov. 7, this steamer sailed from Wilmington, Del., for Greytown, Nicaragua. This vessel is a light draught twin screw steamer for service on Lake Nicaragua, and of a class that is attracting some attention from those interested in the economical transportation of freight on bays and rivers, where the draught of water is limited, and where the side-wheel steamer is principally used.

The hull is of iron and is 136 ft. 6 in. in length over all, 26 ft. beam and 7 ft. deep above cross floors. The model is the same as that of several side-wheel steamers built for service on rivers and bays in South America and Mexico. She has one fore and aft bulkhead in centre, and four athwartship, all made water-tight. The compartment aft is fitted for water ballast to trim the vessel. The frame is of angle iron. The machinery consists of two compound engines with cylinders 12 in. and 21 in. in diameter by 16-in. stroke, fitted with jet condensers. The engines are independent, each driving a propeller wheel 6 ft. in diameter. She has two steel boilers of the locomotive type, fitted for burning wood and constructed for a working pressure of 100 lbs. per square inch. The finished draught of water, with five tons of coal in bunker, was 4 ft. 6 in. aft, and 3 ft. 6 in. forward. On trial trip, with a draught of 5 ft. 4 in. aft and 2 ft. 10 in. forward, she made a speed of ten knots per hour, with 119 revolutions per minute, 94 lbs. 26 in. vacuum; total indicated horse-power 246. During the trial the ballast tank was filled with water.

When she sailed for Greytown she had a cargo of 105 tons of coal, also merchandise and stoves amounting to about 20 tons more, the draught of water being 6 ft. 8 in. aft and 5 ft. forward. Under these conditions, going down the bay she made 9½ knots per hour, with 80 lbs. steam pressure and 108 revolutions per minute.

Prof. L. M. Haupt presented a profusely illustrated description which he has been compiling for some time, of the progress of early American wooden bridge building. Reference was made to the well-known structures of Schaffhausen, 1758, and Wettingen, both destroyed by the French in 1799, and to the remarkable bridges by Wernwag, between 1804 and 1812. A summary of the typical forms as represented in the Burr, Town, Haupt, the Longs, Howe & Pratt trusses was then given with illustrations and reference to the works of Mr. Chevallier, Lavoinne, Pontzen and others.

Attention was called with regret to the fact that the best illustrations and data with reference to engineering works of America were generally only obtainable only from foreign sources.

The paper gave rise to a general discussion, in which Messrs. Cleemann and Graff cited instances of early suspension bridges (Mr. Graff presenting the Club with a photograph of a painting, showing the old suspension bridge at the Falls of Schuylkill, Philadelphia), and reference was made to the early floating draw constructed by the late Henry R. Campbell, at Rouse's Point; also to a wooden truss said to have been built about 1809, over the Terrebonne River, near Montreal, Canada, of 800 ft. span, but of which no very authentic data could be obtained.

A communication from Mr. M. Coryell was received through Mr. Wm. A. Ingham, describing the early structure built by Wernwag, at New Hope over the Delaware, with illustrations of several of the Wernwag bridges. The description was in the handwriting of Mr. Ingham's father, then president of the bridge company.

HOWARD MURPHY,
Secretary and Treasurer.

LIVERPOOL ENGINEERING SOCIETY.

At a meeting of the above society, held at the Royal Institution, Colquitt street, on Wednesday evening, 8th inst., Mr. F. B. Salmon, President, in the chair, a paper, by Mr. C. E. Hannaford Shid, M. Ins't C. E., on the "Testing of Materials for use in Engineering Structures," was read. In the paper the author, for want of space, deals only with two classes of materials, viz.: Limes and cements and metals. He selected these on account of there being many differences of opinion, with respect to some of the methods of testing, and, therefore, will, he hopes, leave more matter for a discussion thereon. After relating briefly the usual tests applied to hydraulic limes, with a view of ascertaining their quality, he passed on to Portland cement. On dealing with this material, reference was first made to the different methods of manufacture, after which he described at some length the various tests to which it should be subjected, including compressive and tensile strength, fineness of grit, weight, color, etc., and then pointed out that by actually breaking sample, by either tension or compression, is given the most reliable information of its quality. He then described and showed, by the aid of diagrams, the various forms of briquette which have been used at various times, giving the reference to the last form introduced by the Metropolitan Boards of Works, as being the one, he believed, calculated to give the most accurate results. He then entered at some length into the various methods of making the briquette, the amount and nature of the water found most beneficial under different conditions, and other details, and concluded this section with some remarks on the utmost necessity in comparing the relative strengths, and other properties of two or more samples, that all the details of gauging and manufacture should be as nearly as possible identical. In dealing with the section on metals, the author described the various, but usually applied, tests to cast and wrought-iron and steel, pointing out several tests which, although occasionally resorted to, are, in his opinion, to be condemned. In referring to the forge test of these last two metals, he quoted the latest tests required by the Admiralty for these metals, and concluded this section with a review of the connection which exists between the chemical and mechanical qualities of iron and steel.

PROPOSED NEW RAILROADS IN VERMONT.

A House bill, introduced by Mr. Fairbanks, of St. Johnsbury, is in amendment of the charter of the St. Johnsbury & Lake Champlain Railroad. It authorizes the building of a branch road from Concord up Moose River, through Granby, East Haven, Brunswick and other towns to Canaan. Some four miles of the road have already been built under the general law. The proposed road lies through a vast lumber region, and its construction will open up a section from which millions of feet of valuable building material will be produced.

The bill to incorporate the Coos Valley Railroad Company has become a law. The charter contemplates building a railroad from some point in the town of Guildhall, Essex county, on the line between the State and New Hampshire, westerly through the towns of Maidstone, Brunswick, Bloomfield, Lemington and Canaan, to the northerly line of the State. The capital stock is fixed at $500,000. This proposed road will open up and develop a great lumber section. House bill 280 extends the chartered rights of the Bridgewater, Plymouth & Ludlow Railroad ten years.

A bill has passed both houses incorporating the Rutland & Tidewater Railroad Company. The proposed road runs from Rutland through Ira, Castleton, West Haven, Fairhaven and Poultney to the western boundary of the State.

The act to incorporate the Brattleboro' & Bennington Railroad Company passed both houses unanimously. The construction of a narrow-gauge road from Brattleboro' to Wilmington has long been agitated by the people living along the line of this proposed road. Several surveys have been made and the route is pronounced a feasible one. The needs and demands of the people along the line are urgent for the building of this road. The distance by the surveyed lines is some 20 miles. Capitalists and prominent business men of the section are back of the enterprise and it will doubtless be pushed to a successful end. Towns along the line are authorized to aid the road by bonding. This part of the county is a fine farming section, and railroad facilities will supply a want long felt. The road will first be built to Wilmington and may ultimately be extended to Bennington.

Railway corporations may be organized and roads constructed under the general law without special charters or specific legislation. Towns are authorized to aid in railroad enterprises by bonding to an amount not exceeding eight times its grand list (the list being one per cent. only of the total property valuation.)

The people of the State have little cause of complaint against the management of the various railroads. The managing officials are uniformly courteous and obliging to the public and the roads are run as a rule for the comfort, convenience and safety of the patrons. Railroading in Vermont is accompanied with difficulties and drawbacks not experienced in less mountainous and more thickly populated States, and the exigency does not seem to have arisen to necessitate such sumptuary and hostile legislation as is proposed in several of the bills mentioned.—*Montpelier Correspondence Boston Journal*, *Nov.* 18.

GOING WEST.

(From "Topics of the Times," in the Dec. Century.)

The young man in the older communities of the East, reading of the marvelous growth of this new western country, often asks himself whether he could not wisely join the ranks of the next annual migration. No doubt the question, "Shall I go West?" is the uppermost problem in the minds of thousands of the young men of the East, who have still their careers to make, and have not yet gained a secure and promising footing in the business world. It is a question which each must answer for himself, and concerning which no advice can be given that would be of universal application. It would be a grievous mistake to suppose that a change of longitude alone insures success. Idleness, incompetency, and a nerveless, drifting disposition have no better chance in Montana than Massachusetts. Indeed, there are some men who run along fairly well in the East, in the grooves of custom and established acquaintance and business connections, who would make lamentable shipwreck if set adrift in a new Western community.

On the other hand, the chances for a young man of average pluck and energy are unquestionably much better in the West than in the East. He shares the advantages of being among the first to open a fresh store-house of natural wealth. He gets the first dividend on the increase of value resulting from bringing population upon the soil. The land he buys for three or four dollars an acre, or gets for nothing by homestead settlement, soon becomes worth ten or fifteen. If he embarks in trade or in any mechanical pursuit, his wares or his services are in brisk demand, because all the new-comers around him require goods and implements. Then there is a certain stimulus in the moral atmosphere caused by the ambitions and energies of a new community full of hope and activity, which makes hardships easy to bear and causes buoyancy of spirits.

Western people find it hard to make their friends in the East understand just what they mean when they speak of the difference in the business and social tone of the two sections. It is a difference to be felt rather than defined. There is vastly more energy and more hope *per capita* of the population in new communities than old, and the immigrant feels at once the resulting stimulus. It braces up the listless and the desponding, and makes even the most active man conclude that there is a deal more in him in the way of work and ideas than he supposed. Many a young man would have remained a clerk or small-salaried employé of some kind all his life, had he stayed in the East, becomes, amid the larger opportunities of the West, a "leading citizen," and the owner of a fine farm or a prosperous business.

The young man going West, can therefore, count upon the opportunities of obtaining good land at small cost, the business openings growing out of the wants of a new community, and the moral incentive that comes from contact with hopeful, enterprising people. If he does not succeed in gaining a full measure of independence in the course of ten years, the reason will lie in his own disposition. He will either lack energy and capacity, or he will be so much a creature of habit and so thoroughly the outgrowth of an older civilization that he cannot adjust himself to the new environments. There are men, as well as trees, that will not thrive when transplanted. The intending emigrant would do well to study his own disposition carefully, and make sure that he is not of that kind.

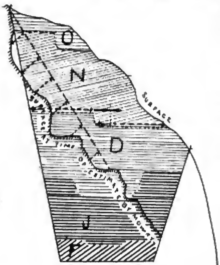
CORRESPONDENCE.

DIFFICULT EARTHWORK MEASUREMENTS.

YELLOWSTONE DIVISION, N.P.R.R.,
BILLINGS, Mon., Nov. 16, 1882.

EDITOR ENGINEERING NEWS:

While agreeing with Mr. Mowry, in his article of November 11, in that it is is no easy task to take measurements for monthly estimates on rock side cuts of 135 feet, may I ask, is not his section at time of estimate left in a very ragged condition, or why permit the station to be worked in such a manner as to require an "assistant to lower himself with a rope hitched from above, and with a graduated pole measure the *ordinate* from the cord?" May I suggest that by using a *templet*, or wooden triangle, with base and perpendicular in proportion to the slope of the cut, in connection with line and bob to bring one side in plumb, the hypothenuse, which will equal the desired slope, may be applied by the laborer himself as the excavation is in progress, thus maintaining, as he should, a uniform and regular surface as an unbroken retaining wall. May I presume to say that a contractor who would create such gouges as appear 15 feet below the slope stake in Mowry's cut, should receive the most severe censure from his engineer, and certainly should not expect the benefit of measurement as is indicated by the ordinate; also, a contractor should finish the slope as his work proceeds, and for his own convenience will maintain a nearly level working surface, which will remove much of the trouble complained of in taking the estimate, and reduce the area to a system of triangles and parallelograms that may readily be computed by referring to the plotted cross-section, on paper especially prepared for that purpose, which is a most satisfactory and a very correct method of portraying the cut. Of course these measurements are taken as the surface requires. In this the curved or warped lines of Mowry's section will be eliminated. Straight lines drawn from point to point of measurement, agreeing with height and distance, will be substituted.



SECTION OF
MOWRY'S CUT.

From my observation, slopes are usually taken out as in areas O . N . D . J . F. in which the letters and quantities they represent indicate each month's work and is the Cross-Section from which the assistant must compute his quantity for estimate. Thus, two methods are available. He can obtain the necessary data by a line of levels from some B. M.; or, by dropping his tape-line from the already located slope-stake, the distance to a convenient point being noted, the measurements for irregularities are carried on by slope-rod and loaded tape, all of which are carefully noted in the field book, and in the office are lightly penciled on the cross-section sheet with a scale correspondingly graduated, from which he can with confidence make up his estimate, also check the contractor's slopes and define the geological strata for classification. In our practice, on slopes of 144 feet, a measurement from slope-stake to line of work only, and scaled on the cross-section as mentioned, is often the only needed data required, as an underestimate is desirable, and especially so during the commencement in taking down a slope, which, together with a percentage held for faithful performance and completion of work, enables the engineer in charge to protect the interests of his patrons, and deal equitably with the laborer.

Respectfully, J. C. ISAACI,
Assistant Engineer.

New York, West Shore & Buffalo R'y,
RESIDENT ENGINEER'S OFFICE,
JERSEY CITY, Nov. 24, 1882.

EDITOR ENGINEERING NEWS:

The communication in your issue of Nov. 11, on "Difficult Earthwork Measurements," illustrates a method of "cross-sectioning" which, I think, deserves further commendation. To obtain the position of a point in a required cross section by means of its direction and distance from a known point, instead of by its vertical and horizontal distances from that point, will, in many instances, prove to be the easier and more accurate method, although the latter is generally adhered to—often, however at unnecessary expense of time and with poor results. In cross-sectioning tunnels and rock cuts with steep slopes—where many of the points are inaccessible to ordinary horizontal and vertical measurements—the use of a graduated arc of a circle in the following manner will be found to be very convenient, the arc being about 200° in extent and 2½ to 3 feet radius.

After running in center stakes where sections are required, the arc is, by means of suitable legs or braces placed in plane of a section to be taken, the 90° mark brought vertically over the center of circle and center stakes with plumb-bob, and the elevation of center of circle noted. The zero end of the tape is then successively carried to the points required in the cross section and their locations are obtained by drawing the tape tightly past the center of the circle, reading the angle on the arc indicated by the edge of the tape, and the distance on the tape to center of circle.

Having the circular form once set up, a large number of points can be located in a short time. I have taken cross sections of roof and sides of tunnel excavation in this way (the zero end of tape being carried on end of pole with a lantern), which, if obtained as accurately by horizontal and vertical measurements, would have required three or four times the amount of work.

Yours respectfully, W. H. ATWOOD,
Res. Eng. N. Y. W. S. & B. Ry.

SANITARY INSTITUTE OF GREAT BRITAIN.

EXAMINATIONS FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

At an examination, held on the 2d and 3d, the following questions were set to be answered in writing on the 2d, and the candidates were examined viva voce on the 3d:

PAPER 1.—1. What are the chief sanitary Acts in force? (*a*) In the metropolis, (*b*) in other parts of England? What are their chief provisions?

2. What are the principal provisions of the model by-laws issued by the Local Government Board with reference to (*a*) building construction, (*b*) house drainage, (*c*) ventilation?

3. What is the primary principle to be observed in the drainage of a town or district, and how would you proceed to determine the size and capacity of the outfall sewer?

4. What rules should be adhered to in regard to gradients, manholes, lampholes, ventilators and flushing in a sewerage system? Illustrate your answer by sketches.

5. Describe the rules that govern the question of sewage disposal at the outfall.

6. How far is a separate system of sewerage desirable?

7. Describe the essential points to be observed in carrying out a system of house drainage. What are the desiderata of a good form of water-closet? Illustrate your answer by sketches.

PAPER 2.—1. What are the first considerations in designing and constructing water-works?

2. Describe the conditions to be kept in view in selecting a source of water supply.

3. How much water has been proved by experiment to be used per head in an average household by constant and by intermittent supply? Compare this with the average expenditure of a large town and explain the cause of the difference, if any.

4. Describe the best means of casting and testing water pipes, and of making joints.

5. What amount of cubic space per head is required for healthy sleeping rooms? Why is it necessary to have a certain amount? What limit of height should be allowed to reckon in the calculation?

6. Describe by a sketch the best transverse section of a paved and of a macadamized street, each 40 feet wide. How should macadam be formed and laid?

7. What is the most economical mode of watering and cleansing streets?

1. What are the provisions of the Public Health act with regard to cellar dwellings?

2. In inspecting a stream which is complained of as a nuisance, to what points would you direct your attention with the view of making a report?

3. Give the dimensions of a sleeping-room which you would consider suitable for six adults, and state your reasons.

4. Describe some of the simple forms of ventilating valves in general use, and explain their action.

5. In what ways may water become polluted after delivery into houses?

6. What are the objections to brick house drains? How should house drains be constructed?

7. What sanitary defects would you look for in inspecting a house where there has been a case of diphtheria?

8. What are the characteristics of various kinds of unsound meat and fish?

NEW PUBLICATIONS.

AMERICAN FOUNDRY PRACTICE.—By Thomas D. West. 361 pp. Illustrated. John Wiley & Sons, 1882. Price, $2.50.

The author has successfully endeavored to select such matter as would best explain difficult castings, and to offer practical molders problems for thought and study. Almost all the more important castings are illustrated by drawings made by the author.

From time to time during the past two years the original articles have been published in the *American Machinist*; they have been enlarged when deemed essential, and in some cases rewritten, until they form a complete treatise upon the subject of molding.

The following main divisions of the book present a good idea of the scope of the work: The Molder and the Foundry, Green Sand Molding, Loam and Dry Sand Molding, Manipulation of Iron Castings, Notes and Recipes.

THE PARIS SEWERS.

The so-called sewers under the city appear to serve little purpose but that of interesting British and American tourists, who delight in being rowed about down below in boats, and are always enthusiastic over the absence of evil smell in the handsomely vaulted and well-lighted passages through which they are conducted. Seeing that the offensive matter which ought to find its way into the sewers is cleared out of the houses at night and carried in carts through the streets, and that vegetable refuse and stale water are habitually thrown into the open gutters to poison the atmosphere, it is not surprising that the air should be, if anything, purer in subterranean Paris than in the magnificent thoroughfares on the surface. It would probably not be rash to ascribe the superior healthfulness of London, as shown by its exceedingly low death-rate, to the fact that the English capital is really drained, whereas Paris is drained only in name. The teeming slums in the east end; the multitudes of factories; the dense, foggy, sunless winters of London have no equivalent here, yet the average death-rate of the French capital, even when no epidemic is raging, is, compared with that of London as 29 to 18; but then if a French tourist were to venture into the great sewer of London he would probably not survive to tell the tale.—*London Telegraph.*

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR...............ASSOCIATE EDITOR.

SATURDAY, DECEMBER 2, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accommodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.25	1.50
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
Journal of the Franklin Institute	4.00	5.00
Van Nostrand's Magazine	4.00	5.00
North American Review	4.00	5.00
Sanitary Engineer	2.75	3.00
Railroad Gazette (new subs.)	3.50	4.20
" " (renewals)	3.90	4.20
American Architect	5.00	6.00
Scientific American	2.65	3.20
Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do this we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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WE call attention to a valuable little collection of tables for railroad engineers advertised elsewhere this week. These tables, bound up in book form for convenience, are the property of the engineering department of the N. Y., W. S. & B. Ry. Co., and have been thus far distributed only to the engineers of that road. At our solicitation, however, a small edition has been ordered to be printed for general distribution without any reference to profit. The price has been placed at one dollar, and only a very limited edition will be printed for sale. We will fill orders only as long as the edition lasts.

THE GOVERNMENT ESTIMATES for public works for the fiscal year ending June 30, 1884, amount to $14,861,715. It is probable that the War Department will ask nothing for rivers and harbors, as there is a large surplus.

THE Christmas number of *St. Nicholas* is, to our thinking, the most exquisite specimen of illustrated magazine literature that has ever been produced in any country. Besides the delicately colored frontispiece "On Christmas Day in the Morning," the eighty pages which make up this unrivalled holiday number, are literally crammed with the very finest specimens of the wood-engraver's art, an art, which it is now acknowledged the publishers of our leading magazines, presumably the the Century Company, have brought to a perfection unequalled in any other country. The *St. Nicholas*, while constituting a monthly "recreation" in art, contains also such recommendations to all lovers of charming stories that it cannot fail to please alike the parents and children wherever it puts in its monthly smiling appearance.

DYNAMITE IN POLITICS.

Dynamite has suddenly assumed a new importance, and become a political question in France. The uneasy politician of the past has become the daring and dangerous conspirator of the present, who uses an agent that leaves the gunpowder of Guy Fawkes by a few centuries, and many more points, behind. French ministers are in a quandary, and the *messieurs des ponts et chaussées* who were just laying out plans for boring a new tunnel through the Alps that would be superior to the Saint Gothard have been considerably non-plussed by a ministerial decree of Oct. 28 by which dynamite is placed under the *haute surveillance* of the police, and otherwise treated with the severity which dangerous characters bring upon themselves. There are no fewer than fifteen provisions in this law, and the legal formalities to be fulfilled are what may be termed vexatious. No longer than eight days storage or supply is allowed in any case, while the transport is so hedged in that only very small quantities can be taken at a time, thus immensely increasing the likelihood of accidents by the greater number of shipments. But the worst of it is the interminable red tape that has to be employed in order to get your dynamite, for it is well known that the French Circumlocutory Office can give even its English rival a point or two in the way of "how not to do it."

The measure has provoked a great deal of indignation among the numerous classes that require dynamite. One trade paper applies, and in no ironical sense, the term of "precious explosive," as if the distinctive name of "dynamite Nobel" was not already sufficient. For there are four of these dynamite companies and they seem to be prospering, if stock quotations can be trusted. The French Dynamite Company makes 110 francs this year, as against 60 francs last year. The Spanish Company has its shares at an equal advance. The great extension of public works in Mexico has given the Mexican Company a large and increasing market, while the Nobel (Fusion) Company is also prosperous. Dynamite, in fact, has become indispensable to the engineer of to-day, and the stupendous works of the last decade became possible only by its aid. It has conquered its place in the mine, the tunnel and the canal. It is a formidable weapon in offensive and defensive military action, and although it cannot be "huckstered" in the market-place it is quoted on "'Change."

But the very strength of dynamite may be said to be its weak point. It really is less dangerous than gunpowder. A spark will not set it off, but like the phlegmatic individual it is fearful when it receives the necessary incitement. Nitro-glycerine, dynamite, etc., have, however, a political history, which is exciting the hopes and fears of too widely different social classes. The killing of the Czar of Russia was the work of dynamite. The Nihilists have taken to it with their own peculiar enthusiasm, and now French and European socialists in general are looking to it as the great instrument for realizing their wild dreams. A large dynamite manufactory was recently discovered in Switzerland, and it is no exaggeration to say that there are good grounds for the uneasiness which exists in some of the European cities, at the terrible danger which it is possible for some devils in human shape to hang over them. Lately, in Lyons, a crowded restaurant was terribly shaken, and threats have been made to blow up theatres and generally, to smash up things. The terrible effects of nitro-glycerine in the Thomassen affair in the Bremen docks some years ago are still in the recollection of all—effects so terrible that the fiendish perpetrator committed suicide almost immediately afterwards. Dynamite, as one of the most powerful of known agents, should not be placed in the hands of ignorant or wicked men, and its manufacture should certainly be surrounded with precautionary restrictions. The criminal negligence which lately resulted in the extermination of a family in Pennsylvania is only a specimen of the reprehensible way of dealing with this explosive, and engineers and contractors would do well in their own interest to adopt the utmost care and caution with its handling. It is one of those articles of which a little goes a long way, and which will not be trifled with.

Some years ago an Irishman and his to-be-presumed gentle spouse were taking a walk along the Erie basin in Jersey City. The Celtic eye was attracted to a small tin vessel; the gentleman picked it up, and impelled by a curiosity that was rather idle than scientific, he undertook to investigate a certain yellow matter which, like a solder, ran along the rim. He used a pen knife for the purpose, and began to scrape—The lady was fished out of the basin after some trouble very considerably astonished, and doubtless laying the blame on her "lord and master." He, however, had his arm wrenched from his shoulder and was otherwise maimed. It would be a poor consolation to the victim to inform him that such tremendous force could be explained by chemists as the instantaneous combination of hydrogen, nitrogen, carbon and oxygen atoms.

Seriously, however, dynamite threatens to have a political evolution and revolution in its train. Perhaps some day there may be some new agent started that will set the very air on fire, and

> "Strike flat the thick rotundity o' the world,
> Crack nature's moulds, all germens spill at once,
> That make ungrateful man !"

PHILADELPHIA WATER-WORKS.

A "sub-committee on municipal abuses" of the Committee of One Hundred in the much governed City of Brotherly Love have requested Howard Murphy, Secretary of the Civil Engineers Club, of that city, to recommend a fitting man for the office of Chief Engineer of the Department. The *Evening Telegraph* of the 24th ult. contains Mr. Murphy's response to this rather delicate undertaking. Two very safe men—Mr. Frederic Graff and Mr. Isaac S. Cassin—meet Mr. Murphy's approval, and their names have accordingly been submitted to the committee. We give in our "Personal" column Mr. Murphy's sketch of the professional career of the two gentlemen named, either of whom, it will be conceded, may be considered sufficiently qualified for the office designated.

In his communication, Mr. Murphy specifies as follows: "Honesty, industry, and peculiar executive ability, and firmness in the management of men and things, are of the utmost importance, too, in that great department of this great city. There, the engineer should be the manager, and no one unprepared by this kind of experience, also, should be allowed the place." Now, if we are not very much mistaken, the present Chief Engineer, Dr. McFadden, possesses in an eminent degree these very qualifications; in fact he possesses them so markedly that the City of Philadelphia has been the gainer by hundreds of thousands of dollars during his administration, while the office-holding leeches that had previously fattened on the water revenues have dropped off and are now doing their level best to turn the tables on the "Doctor" whose "executive ability and firmness" were too much for them and their "backers."

The word "Chief Engineer" like most other designations of Philadelphian office-holders is a misnomer. Dr. McFadden is properly the "Water Commissioner" and the office calls for "executive ability and firmness" more largely than it does for special knowledge of water-works construction and management. The real engineer of the Philadelphia Water Works is Mr. Chas. G. Darragh and a comparison of the condition of the Philadelphia Water Department now, and when Dr. McFadden was put in command will prove a record not to be ashamed of.

Can any Department in the City Government of Philadelphia be named that has not as its head, a politician rather than a man, who professionally might be considered the fitting person to fill the position—if so which is it?

◆

PERSONAL.

W. F. GARIS is appointed chief engineer of the Burlington and Ohio River railroad, and will have entire charge of the construction of the road, subject only to the board of directors.

MR. FREDERICK GRAFF, whose honored father designed and constructed the original Fairmount Works (an engineering monument of their time), was their Superintendent before Consolidation. After Consolidation, upon the creation of the Water Department, which included the Fairmount and other works, he was made the first Chief Engineer, and served for the years 1854 to 1856. He was again elected in 1867 and served until succeeded by Dr. McFadden. He has since been engaged with the Worthington Pump Works, and, for many years, in various important engineering pursuits.

MR. ISAAC S. CASSIN was educated at Westtown school; served apprenticeship with Messrs. I. P. Morris & Co. as machinist and mechanical engineer; was engaged as Superintendent, 1852 to 1856, in construction of hydraulic and mining machinery and the introduction of the Cornish pumping engine; was Engineer of the Spring Garden Water Works, Philadelphia, 1856–57–58; Chief Engineer Philadelphia Water Department, 1862–63–64; Chief Engineer United States Mint, 1867–68–69, and has designed and constructed complete waterworks at Chester, Oxford, Pottstown, Coatesville, Ashland, Media, Phœnixville, Conshohocken, Swarthmore and Louella, Pa.; Bridgeton, Burlington, and Salem, N. J.; Ithaca and Owego, N. Y., and New Castle, Del.; also, important parts of, or designs for, works at West Chester, Meadville, and Lancaster, Pa.; Lambertville, N. J., and Wilmington, Del.

GEN. DANIEL TYLER, a veteran United States soldier, died on Nov. 30, at the Fifth Avenue Hotel, this city, aged 88 years. He was born in Brooklyn, Conn., graduated from West Point, and was the oldest graduate of which there was any record. In 1828 he was sent to France by the government to study the improvements in the art of war; in 1834 he resigned from the service, and, turning his attention to civil engineering, he soon became extensively interested in railroading. He was the President of the Norwich & Worcester Railroad Company from 1840 to 1844, of the Morris Canal and Banking Company, of New Jersey, from 1844 to 1846, and of the Macon & Western Railroad Company, of Georgia, from 1846 until 1848. He was a member of the Board of Visitors to the Naval Academy in 1849, and from 1850 until 1861 he successively held the positions of Superintending Engineer of the Cumberland Valley Railroad, of Pennsylvania; General Superintendent of the Dauphin & Susquehanna Railroad & Coal Company, of Pennsylvania; Superintending Engineer, and afterward President, of the Auburn & Allentown Railroad, of Pennsylvania, and President of the Schuylkill & Susquehanna Railroad. He served through the civil war, and since its close has been interested in railroad and manufacturing enterprises. He was President of the Mobile & Montgomery Railroad from 1873 to 1878, and owned large interests in cotton mills and iron furnaces in Alabama.

SIGNAL SERVICE OFFICE NOTES.

An unpretentious but very useful little publication just issued from the Signal Service is that known as No. III. of the "Notes," which has been prepared by Lieut. James Allen. It is a pamphlet of eleven pages, whose purpose is to enable farmers and others who are engaged in the raising of crops to foretell—and, consequently, to guard against the effects of—frost. It is more particularly designed for the use of such persons as live in places not reached by the warning bulletins of the Signal Service. In determining whether a frost may be expected use is made of the well-known dry and wet bulb hygrometer, which consists simply of two similar thermometers, one of which has its bulb covered with a bit of muslin kept constantly moistened by being connected with a cup of rain or distilled water by means of a few threads of darning cotton or a narrow slip of muslin. The dryer the air the greater the evaporation from the wet muslin and the lower the reading on the scale attached to the wet bulb thermometer. This reading is subtracted from the reading of the other thermometer, and the difference is made use of, by reference to the table prepared for this purpose, in determining the dew point. The dew point indicates about the lowest temperature which will be reached during the night under ordinary circumstances. When the air is cooled down to this point dew is deposited and the latent heat given out arrests a further decline of temperature. When the air becomes warmer the loss of heat by radition from the plant and other surfaces speedily cools it, and the temperature, therefore, oscillates about the dew point. This point being ascertained, it is evident that the approach of frosts can also be determined beforehand and precautions taken in time to prevent the doing of harm. A minimum thermometer for showing the lowest temperature is a useful adjunct to the hygrometer. The Signal Service Office is prepared to furnish to observers accurate instruments at the actual cost price. To insure accuracy the instruments should be kept in a shelter, designs of which are given in Lieutenant Allen's pamphlet, which also contains full directions for taking observations and for making the necessary calculations. By the issue of this pamphlet the Signal Service office does not intend to curtail any part of its system for frost warnings, which are to be this fall on a very extensive scale. Two special bulletins will be issued each each day, at 1 a. m. and at 10 a m., and will be sent by telegraph to the press, to exchanges, plantations, etc. How much the system is extended for the tobacco interests is shown by the fact that forecasts affecting the growth of "the weed" are to be sent to twenty-one distributing points in eleven different States and the District of Columbia, and from these points they are to be repeated at five hundred and sixty-nine other places.

◆

THE EDUCATION OF ENGINEERS.

INDIANAPOLIS, Nov. 19.

TO THE EDITOR OF THE RAILROAD GAZETTE:

When I read your article of Nov. 10 on "The Education of Engineers," for which my letter of inquiry furnished the "excuse," I felt that mine was decidedly a case of "misplaced 'confidence'"—much as if I had sought light on a question of banking from an original thinker like Dennis Kearney, and been told, with some warmth, that, to begin with, banks, bankers and banking must go. Comment seemed useless, and I felt disposed to "change the subject;" but reading some letters in your paper of the 17th, just received, I am moved to ask space for "a few remarks."

I want to set myself and the "young man" right.

The "assistance" (from your putting it in quotation marks I suspect the word struck you with an emphasis not intended) was asked for, not "to aid the writer in advising a young man," but for the young man himself, whom the writer felt incompetent to advise.

The card of the writer does not advertise him as one of a firm "engaged in practical engineering work," but as a *contractor*.

The young man does not contemplate "a classical course at Oxford" or anywhere else, and he entertains no "foolish notions" whatever to justify the spirit and much of the matter of your comments on my letter. The things he has in contemplation are going into the field on surveys, or into a shop of some sort to work for wages, or entering a "mechanical school," where doubtless he thinks he can get, with some saving of time, a wider knowledge of materials, mechanical processes, etc., for a foundation on which to build hereafter, as opportunity shall permit or the nature of his untrained work suggest. And he talks of attending scientific lectures in his hours of leisure and of getting incidentally more German and French, that he may have access to the technical works and journals of those languages.

In all this you may see "reasons for suspecting that he entertains illusions" of various sorts; but, as a matter of fact, he is a man bent on *work* towards an end, as he sees it; and the end he proposes to himself is "to be a civil engineer, and to make a specialty of railway construction and management."

Now, there was a gentle savage once (so Franklin says) who heard the missionary patiently on "Man's First Disobedience," and at the conclusion of the story observed, with native and untutored politeness, "What you say is true; it is indeed wrong to eat apples; better make them all into cider!" In the same conciliatory spirit I am disposed to admit that because the word engineer presupposes an engine, and for other reasons "too numerous to mention" (and with which also I am not acquainted), "engineer and all its derivatives" and combinations ought to be abolished—with the exception, mark ye, of mechanical engineer, which I would reserve for Matthias. Edmund must indeed eschew the addition civil engineer, though Angeline weep.

Webster (whom I never swear by on questions touching the nice use of words, except when he happens to agree with me) says a civil engineer is "a person skilled in the science of engineering, who designs and superintends the construction of public work or machinery," and, below, "civil engineering," he says, "refers, according to modern usage, strictly to the construction of *fixed* public works, such as railways, canals, bridges, light-houses, sewers," etc. Now what our "young man" wants to do is to become skilled in the science of engineering, and especially in that part of it which relates to designing and superintending the construction of railways. There are thousands of men doing precisely this sort of work throughout the civilized world. The thing exists, and needs no apology for its being, but it *does* need a name. These men are not stone-cutters, or pile-drivers, or section bosses, or contractors, or signal makers. Until you fill the void we are constrained to call them civil engineers.

It takes some dozens of different sorts of men to complete a great building. There are hod-carriers, stone-cutters, masons, carpenters, plasterers, iron-workers, etc., and finally an architect; and the chances are *no two of them, not even the stone mason, and the brick mason could change places*, and certainly *no one kind* of them could do the whole. Is it any disgrace, or even disadvantage to the architect, that he cannot carry the hod, or plaster the wall! If you would advise him to carry the hod as a part of his education, why not insist on his learning practically every one of the forty trades and callings represented on his building? Do you suppose that if you had all the rest you could build your building without the architect?

If you could "banish the term civil engineer" by an act of the legislature or an editorial in the *Railroad Gazette*, the difference would remain between the railroad grader, the mason, the pile-driver and the —— fellow who lays out the work for all of these and keeps a trained eye on the work as it progresses.

The engineer is the man to whom, not wholly but more than to any other, we owe the conquests that have been made within this century over material obstacles, the substitution of strain sheets for guesses, the abandonment of such wasteful use of material as may be seen in the Victoria Bridge, the substitution everywhere in his own broad province of definite knowledge and the clear purpose for confusion and blind groping. He has done much, and much remains to do; and he will do that best who brings to the work the formulated experience of his predecessors, a firm grasp on the principles they have painfully worked out, a good store of common sense, and much practice; but *practice in the strong light of all of these.*

There was a time when the physician was a barber, but medicine has made such progress since the two trades were divorced that they will never be reunited. It is not so long since the mason was the engineer, and since there was not much engineering science extant in those days, a knowledge of one's A, B, C's and the multiplication table might then have been a liberal education to start on. The oldest of our living engineers began with a slender equipment of theoretical knowledge, partly because there was nothing better to be had. But those of them whose work is a real legacy to their successors did not end so; and the young man who expects to build high in the profession of civil engineer *to-day* would best begin, as nearly as may be, where they left off. Every year now the necessity for a *solid foundation in science* ("*definite knowledge in contradistinction to that indefinite knowledge possessed by the uncultured*"—"I thank thee, Jew, for teaching me that word") will be more apparent.

These are "glittering generalities." Had I been capable of anything much better I should not have called on you to assist our "young man."

I want also to join my protest to that of another correspondent against your "alleged" definition of success.

Would you button-hole a young man reading law and say to him, "see here, my young friend, what you want to do is to drop all this nonsense about 'principles' and 'philosophy of law' and all that sort. The less law you have the better; it is *petty juries* you'll have to deal with. Study human natures, its passions and prejudices. What you want to do is to *succeed*, win cases, get verdicts, get money; you *understand?*"

Would you say to the innocent who contemplates adopting the profession of medicine, "Now, my boy! bear this in mind, that a very little knowledge goes a great way in *that* trade. Just as soon as you know the difference between calamus and calomel, and can write a prescription that no one but a druggist can read, you sail in and *practice*. You will pick up the rest fast enough, and your success, that is your profit, will depend more on your *tact* in managing people than on *anything else*. If you want to get rich you must be *popular; that's* the point."

For God's sake! when you see a young man putting his heart, his brain and his hands into work, bent on doing it *well*, don't pluck him by the sleeves and whisper in his ear the mercenary wisdom (?) which old age and hard knocks have brought you—and may, perhaps, bring him soon enough—to all our loss.

The "young man" we are talking about wants to succeed *and* to make money; but to make it as a civil engineer.

S.,
Contractor.

Ye OLDE-TIME SURVEY.*

One hundred and forty-seven acres 3 roods and 19 rods, after deducting whatever swamp, water, rock and road areas there may be included therein and all other lands of little or no value, the same being part of said deceased's 1,280-acre colony grant, and the portion hereby set off being known as near to and on the other side of Black Oak Ridge, bounded and described more in particularly as follows, to wit: Commencing at a heap of stones about a stone's throw from a certain small clump of alders, near a brook running down off from a rather high part of said ridge, thence by a straight line to a certain marked white birch tree about two or three times as far from a jog in a fence going around a ledge near by, thence by another straight line in a different direction around said ledge, and the "Great Swamp" so called, to a corner of the "King lot" so called, thence in line of said lot in part, and in part by another piece of a fence which joins on to said line, and by an extension of the general run of said fence to a heap of stones near a surface rock, thence as aforesaid to the "Horn," so called, and passing around the same, as aforesaid, as far as the "Great Bend," so called, and from thence to a squarish sort of a jog out in another fence, and so on to a marked black-oak tree with stones piled around it, thence by another straight line in about a contrary direction, and somewheres about parallel with the line around by the ledge and great swamp to a stake and stone bounds not far from the old Indian trail, thence by another straight line on a course diagonally parallel or nearly so with "Fox Hollow Run," so called, to a certain marked red-cedar tree out on a sandy sort of a plain, thence by another straight line in a different direction also to a certain marked yellow-oak tree on the off side of a knoll with a large flat stone laid against it, thence after turning around in another direction and by a sloping straight line to a certain heap of stones which is by pacing just 18 rods and about one-half a rod more from the stump of the big hemlock tree where Philo Blake killed the bear, thence to the corner begun at by two straight lines of about equal length which are to be run in by some skilled and competent surveyor so as to include the area and acreage as hereinbefore set forth.

MEAN ANNUAL RAIN-FALL.

We make the following abstracts from a paper written on this subject by Prof. Elias Loomis, of Yale College, and read before the recent meeting of the National Academy of Sciences. From the observations made and recorded it appears that on one-fifth part of the land surface of the globe the average annual rain-fall is less than 10 in., and that on even a larger surface the fall is so slight as to render the land valueless for agricultural purposes, except in the limited districts which permit of irrigation. There is an extensive rain belt along the Atlantic coast from 35° north to 33° south, with the exception of districts in Mexico and Texas, where the average rain-fall is 50 in. There are belts of country across South America, and Africa and the islands of the East Indian Archipelago which form an equatorial rain belt of about 1,000 miles in breath where the rain-fall averages 50 in. There are also similar belts across Africa, Asia, and in sections of Australia, North and South America, where the rain-fall averages only 10 in. and even less, but the only portion of Europe which is properly termed a rainless district is a small portion of Spain, where the fall is less than 10 in. per annum. The most remarkable rain belt extends from the Atlantic coast across Northern Africa and eastward to the Indus, its length being 4,500 miles and its breath 1,000 miles, in which the rain-fall is about 75 in. Prof. Loomis drew no deductions from his observations, but, in a paper read later on, Prof. Guyot, the geographer of Princeton College, read a paper on the existence in both hemispheres of a dry terrestrial zone. These dry or rainless zones, whose location were vaguely designated in Prof. Loomis's paper, were more distinctly marked out on a map exhibited by Prof. Guyot. These zones he denominated as semi-tropical zones, and are situated both north and south of the equator, extending across a well defined belt of country. The southern semi-tropical zone is nearer to the equator than the northern semi-tropical zone, a fact which the professor held was due in part to the fact that the amount of land in the northern hemisphere overweighted that in the southern, and so lifted further to the north the whole meterological system of the southern hemisphere. The cause which leads to the existance of these two rainless zones is the construction of the country bounding them. The country about the partial deserts existing is such as to draw from the atmosphere all the moisture it has before the winds reach the dry country. This is generally the cause, the most notable exception being in the dry lands of Peru, where, though there is no rain, there is much moisture in the atmosphere, which is precipitated, and serves its purpose without condensation. In the course of his remarks he stated that the Mississippi Valley would be, by reason of the construction of the country on either side, a vast desert were it not for the existence of the Gulf of Mexico, the warmest body of water on the face of the earth, and one that helps very materially in supplying the rain-fall for that part of this country.

THE MEANING OF AN "INCH OF RAIN-FALL."

It appears that in the west and southwest of England the amount of rain measured in the course of the past fortnight has been just about double the average for the entire month of October, while over the Midland and Southeastern counties it has been about half as much again as the monthly average. In London rain has fallen every day, and on five days out of the fourteen the amount has been at least half an inch, the aggregate for the period being about 4¼ in. To the ordinary unscientific individual, whose notions on the subject of rainfall are, as a rule, somewhat vague, an inch or two more or less of rain may appear a trifling matter, and 4¼ in. in a fortnight a comparatively insignificant amount. Few persons are aware that an inch of rain over an acre of ground means 101 tons, or 22,623 gallons of water. Accepting as correct the Registrar-General's estimate of the gross area of London and its immediate suburbs, it would therefore appear that an inch of rain over the London district weighs in round numbers 45,000,000 tons, and amounts to the overwhelming volume of 10,000,000,000 gallons of water. With these figures in mind, the serious effects produced by a sudden downpour, such as we occasionally get in thundery weather, or by a long-continued spell of wet such as we have recently had, do not seem at all surprising. Estimating the total amount of rain in London during the past fortnight as 4¼ in., and applying this amount to the above figures, we find that the weight of water which has fallen has exceeded 190,000,000 tons, while in volume it has amounted to 42,500,000,000 of gallons. In attempting to grasp such enormous numbers, the mind becomes lost, but some idea of the immensity of the volume may be gained by imagining it all to be concentrated into one reservoir or basin. Supposing such a reservoir to be square and 40 ft. in depth, the sides of the square would be more than 13,000 ft. in length, and a walk round it would entail a journey of very nearly 10 miles. If we imagine the water to be inclosed in a cubic vessel, the sides of such a receptacle would be each about 1,896 ft. long—*Daily News of London*.

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We learn that a large city, which is in need of the services of an expert civil engineer, for special work, is sending letters to a number of such persons, asking their terms. This is a penny wise and stupid way of doing business, and suggests a very low order of intelligence on the part of municipal authorities. Engineers of ability and reputation are not to be obtained by this kind of dickering.—*Sanitary Engineer*.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Hyde Park, Ill., New Gas Works The Chicago *Times* notes the sale of certain land to the Metropolitan Gas Company and gives the following account of the organization: "This purchase was made as the first step towards actual operations by the Metropolitan Gas company, organized in May, 1881. In May, 1881, the newly-organized company applied to the board of trustees of the village of Hyde Park for a charter to erect gas works for illuminating, heating, and mechanical purposes, and intended to supply that village with gas. As responsible parties in this city were shown to be interested, and pledged to see the works built and operated, it took little argument to obtain the charter and a contract to supply all the gas needed for the purposes named. Since the obtaining of the charter the gentlemen originating the enterprise have placed the stock among themselves and other local capitalists, who have aid in a working capital, and the work of erecting the works will commence immediately. The capital stock is $500,000. No plans have as yet been determined further than the following: The entire ground purchased will be improved with the buildings. These will be of very handsome design. First-class talent will be employed upon the plans, and the works will be such as to be an ornament of the beautiful suburb and a credit to Cook County. They will cost, as estimated, from $225,000 to $250,000. Fifteen miles of main will be put in without delay, and if it is possible to work without intermission though the winter it will be but a few months when gas will be supplied all over the village, not only as light but for heating purposes. The process will be either the Lowe water, the Springer, or other late process. The one which will furnish the best quality of gas at the lowest price will be adopted. It is designed that the general style of the buildings and the character of the whole plant shall equal anything in the west. The entire arrangements will be made known in a week or two."

Work on the artesian well at Steelton, Pa., has been suspended at the depth of 720 ft. A pump was inserted, but the flow is not up to expectations.

Tank at Manchester, Va.—The tank on the water-tower which has been erected on the premises of the Richmond & Danville Railroad Company, near the Free bridge, is to be 16 ft. high and 20 ft. across the brim. It will hold 500,000 gallons of water. The structure is 85 ft. high, and several of the lower stories will be used as shops and offices.

The Manchester, Va., Reservoir was cleaned recently, about 40 cartloads of muddy *débris* being removed.

An Artesian Well.—Lincoln, Neb., Nov. 21.—Workmen excavating a well for a water-works to-day struck an artesian vein 40 ft. from the surface of sweet, pure water in inexhaustible supply. The water rises to 5 ft. of the surface of the ground, and insures the prompt construction of water-works for the city.

The City Solicitor of Lynn, Mass., has decided that the Council has no authority to supply Swampscott with water. That town will have to look for some other source.

ELECTRICITY.

The certificate of incorporation of the Colombia & Venezuela Telephone Company has been filed in the office of the Clerk of Monmouth County, at Freehold, N. J. The company has a capital of $100,000, and will build and operate telephone lines in the United States of Colombia and Venezuela.

A Telephone Cable.—The Southern New England Telephone Company laid a 21-wire cable across the Thames River, from Winthrop Point to the Groton shore, thereby putting the States of Massachusetts, Connecticut and Rhode Island on speaking terms.

Electric Light in Mexico.—On Nov. 20, the plaza of Monterey was lighted by electricity for the first time.

Electric Lights for Hell Gate.—Washington, Nov. 25.—The extreme estimates of the Electric Light Company for lighting Hell Gate by electricity are $14,000, which amount includes the erection of the proposed tower and furnishing the light. The contract will probably be awarded at that figure.

RAILROADS.

The circulation of false news to bolster up the credit of new railroad enterprises is an industry which some people have practiced with great assiduity of late years. Three or four persons with very little money and no credit start a new railroad enterprise. They have a survey made, and take care that every smallest step be heralded throughout the country. Apparently the various press associations and their correspondents in the country accept and forward any news of the kind if those who furnish it will pay for telegraphing, on the theory that editors will use their discretion in publishing what is sent them; but as the editors must often depend upon their agents on the spot to judge of the importance and especially of the accuracy of the news sent them, they are likely to publish what is sent them as important news. In this way the newspapers sometimes become, as it were, the decoys in a great confidence game. The railroad projectors in search of capital or credit, and not able to obtain either on the merits of their enterprise as presented to capitalists, use every exertion to spread the opinion that their road is wanted badly by some corporation or interest that can pay well for it. It is telegraphed all over the country that Vanderbilt wants it and Gould wants it, to-day that this one is likely to secure it, and to-morrow that the other is making a better offer; and after a month or two of this lavish use of the telegraph, the name of the enterprise becomes familiar in the public mind, and many come to regard a preliminary survey and a few miles of grading as an established company, to which it will be safe to sell rails and rolling stock and perhaps to lend money.

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* Copy of a mutual distribution by Probate Records of Connecticut in 1812.

And this use of the telegraph to magnify the importance of a company is not confined to new companies. Some companies with roads in operation (whose managers usually have a load of stock or bonds to sell) somehow manage to have the most trifling facts that may tell in its favor published far and wide, together with various rumors as to the great things it is going to do, the importance of a new connection likely to be negotiated, or of a new line which it contemplates building. And in most cases these roads and projects concerning which so much "news" is published in the newspapers are among the most worthless in the country. When we find telegrams week after week announcing that Gould and Vanderbilt are contending for the possession of some unbuilt line in Illinois or Iowa, we may safely infer that some one is very anxious to sell the line, and that if he does not sell he will have great difficulty in getting money to build his road.—*Railroad Gazette.*

NEW RAILROAD COMPANY.—The Secretary of State of Illinois has granted corporation papers to the South Chicago Elevated Railway Company; capital, $2,000,000. Articles have also been filed by the Albion, Carmi & Shawneetown Railway Company, to be constructed from Olney, Richland County, via Albion, in Edwards County, and Carmi, in White County, to Shawneetown, principal office in Carmi; capital stock $1,000,000; also by the Effingham & Northwestern Railroad Company: this road is to be constructed from Effingham, in the county of Effingham, Ill., to a point on the Toledo, Cincinnati & St. Louis Railroad, between Stewardson & Cowden, in Shelby County, Ill., principal office at Effingham; capital stock, $200,000.

THE Atlantic & Pacific have completed their road 403 miles west from Albuquerque, New Mexico, and have 157 miles yet to reach the Colorado River, where they are to meet a branch of the Southern Pacific. The Southern Pacific have their track completed 64 miles east of Mohave.

A BIG INCREASE OF CAPITAL STOCK.—MONTREAL, Nov. 28.—The Canadian Pacific Railway Company to-day raised its capital stock from $15,000,000 to $100,000,000.

THE BOSTON *Journal* says that the Oregon Short Line will stop at Boise City, not continuing to Baker City, as was intended, and that when any future extension is made it shall be in the direction of Portland and Central Oregon.

WISCONSIN NOTES.—A dispatch from Milwaukee states that the Chippewa Falls & Superior line of the Chicago, St. Paul, Minneapolis & Omaha Railroad has been completed to Hudson. The Bayfield line will be finished to Ashland by Jan. 1. Both lines secure to the railroad company two valuable land grants in Northern Wisconsin—that of the old Chicago & Superior Line Company and what is known as the Northern Wisconsin grant. The connections between the road named and the Northern Pacific at Superior are finished.

A NEW RAILROAD FOR STATEN ISLAND BEGUN.—Ground has been broken for the new railroad to run from West Port Richmond across Staten Island, through Richmond to Eltingville. It is to be called the North & South Shore Railroad of Staten Island. The road is expected to be completed by May next. A hotel and large wharf will be built at Prince's Bay. It is the intention to run fast express trains morning and evening, so that the trip from the southern terminus to New York by rail and boat can be made in fifty minutes.

THE Canadian Pacific Railway has its track laid a distance of 584 miles west of Winnipeg. Graders have reached a point 45 miles farther, and within 45 miles of Saskatchewan crossing and Medicine. Fifty-five miles of rail will yet be laid this season, and the road to the river graded during the winter.

THE INDIANA & OHIO RIVER.—TALBOT, Ind., Nov. 25.—Engineer R. A. Hamilton, of the Chicago, Indiana & Ohio River Railroad, arrived here with his corps last night on the line to Terre Haute. This will make a direct line from the coal-fields to the lakes.

ANOTHER RAILROAD IN MAINE.—A petition has been addressed to the Legislature of Maine by the inhabitants of Poland, Gray and neighboring towns, praying for a charter for a railroad from some place near Mechanic Falls, about twenty miles southerly to a junction with the Maine Central Railroad near Gray. This would be a prolongation of the line of the Rumford Falls and Buckfield Railroad, which would thus secure a new outlet to Portland and furnish railroad facilities to a new tier of towns. The road is now in operation from Mechanic Falls to Canton, twenty-seven and a half miles, and the proposed extension would make a line of about fifty miles.—*Portland Press.*

A WORK OF NECESSITY.—Some time since the Chesapeake, Ohio & Southwestern Railroad changed the gauge of their road on a Sunday, and the Grand Jury of Caldwell county indicted the company for the performance of labor on Sunday. Judge Grace, at Princeton, O., on Thursday decided in favor of the company.

THE track on the Woodstown & Swedesboro Railroad, New Jersey, is laid beyond Woodstown, and will be completed about the 15th of December. Leach & Baldwin are the contractors.

A GOOD LOCOMOTIVE RECORD.—N. Taft took engine No. 38 to run out of Susquehanna shop in the year 1868, and give it up Oct. 21, 1882, on account of putting hard-coal burners on the passenger trains. He has run engine 38 4,491 times over the Delaware Division (New York, Lake Erie & Western)—which is 105 miles long—making a grand total of 471,555 miles run—which only lacks 3,445 miles of running 19 times around the world. The engine is in good condition now, and with proper care it will last two years yet. There has been nothing new put on No. 38 since it ran the first trip excep a pilot, tank frame, cylinders, and the usual every day repairs to the engine. It has the same cab, headlight, bell, drivers and tank that were on the engine when he took it.—*Port Jervis (N. Y.) Gazette.*

MICHIGAN CENTRAL.—The Detroit *Post and Tribune* says: "General Manager H. B. Ledyard, of the Michigan Central Railroad, returned from New York Tuesday night, at which point he has been for the past ten days, and brought with him the plans and specifications for the new Michigan Central depot. The design, which is by an Eastern architect, is intended to meet every requirement, present as well as future, and in an artistic sense will be a credit to the corporation and Detroit. The dimensions over all will be 184 by 400 ft., and the depot building proper with all the various offices is to be 100 by 184 ft., three stories high, and will occupy the southwest corner of Third and Woodbridge streets. Adjoining the above on the west will be a two-story building, and a one-story coach or train sheds will cover the passenger platforms between the tracks. The latter will be uncovered. It is intended that passengers shall pass from the waiting rooms and ticket offices of the main building through a vestibule to the trains, which will be separated from the depot proper by fences, as greater security and regularity are thus obtained. The entire structure, including sheds and annexes, is to be built of brick, with brown stone trimmings, and at an estimated cost of $175,000. It is intended to have the building completed in ten months' time, and the work of removing the present structure will commence at once. The architect is expected to arrive the early part of next week, and will then proceed to elaborate the general plan of the building more fully than has yet been done."

A PULLING TEST OF STANDARD AND NARROW GAUGE ENGINES.—Railway men have been much interested in seeing the pulling capacity of standard and narrow-gauge engines tested, side by side. The St. Louis, Iron Mountain & Southern and the Texas & St. Louis (3-feet gauge) roads have parallel tracks at Bird's Point, opposite Cairo, from the transfer wharf at the river running up the bank with a grade of about 190 ft. to the mile, and with two degree curves. The Texas & St. Louis has four rails—for 3 ft. and 4 ft. 8½-in. tracks—and it has been hauling up standard gauge cars with a narrow gauge engine. This engine, a consolidated, with cylinders 14x20 and eight drivers of 36 in. has pulled with ease up the steep incline six broad-gauge cars five of them loaded with 15 tons each and one with 23 tons, making a total of 98 tons, while the Iron Mountain engine, a consolidated "pony," with cylinders 17 x 22 and six 4½-ft. drivers, has hard work to pull an equal load, and frequently finds three or four cars sufficient. The narrow gauge men are enthusiastic about the power of their engines, and claim that the moguls could pull up eight loaded cars, if the cars as well as the engine were on a track of 3 ft. gauge. This engine has a rigid wheel base of 14 ft. 7 in., and weighs about 28 tons loaded. She has pulled up this incline 8 narrow gauge cars loaded with about 15 tons of dirt each. Thus far the little narrow gauge more than holds her own against her bigger—or wider—competitor in respect to capacity and economy. Connotton Valley and Toledo and St. Louis stockholders should derive encouragement from this test of the respective gauges.—*Boston Journal.*

TUNNELS.

TUNNEL COMPLETED.—A note from Walter Katté, chief-engineer of the New York, West Shore & Buffalo Railway, dated Nov. 24, says: "I have just received a dispatch from West Point stating that the entire excavation of the tunnel is completed, and that the last brick in the arching of the same will be completed by noon to-morrow."

CANALS.

EAD'S SHIP CANAL.—A dispatch to the *World* from St. Louis says that Captain Eads stated that he has so enlisted English capital in his Tehuantepec Ship Canal project that the completion of that work does not depend upon any action Congress may take in the proposition he submitted at the last session.

CONTRACTS LET.

BRIDGE CONTRACT LET.—The Department of Public Parks of this city has let the contract for building the iron superstructure of the Madison Avenue bridge to the Keystone Bridge Company for $159,389.40.

CONTRACTING.

THE UNION IRON AND STEEL COMPANY.—CHICAGO, Nov. 18th, 1882.—Dear Sirs: This company now have in use your Asbestos and Hair Felt (Double Air Chamber) Covering on Steam Pipes, aggregating over twelve thousand (12,000) square ft. of surface.

I think the combination a good one, and am so well satisfied with the results, that I am having all of our new pipe-connections covered in the same manner as fast as they are completed. Yours, very truly,

R. R. JONES, Gen. Supt.

H. W. JOHNS, Esq., New York.

BUILDING.

THE *Lancet*, in noting the tendency in London to substitute flats for private houses, calls attention to the bad sanitary condition of most of the existing apartment houses, and warns the public against such future modes of construction as will expose occupants to the danger of sewer gas and difficult ventilation. The servants' quarters in existing flats are specially referred to as liable to engender disease, as they are either without windows or are "ventilated" by a hole over the kitchen sink.

BIDS FOR GLASS.—Bids were opened at the Treasury Department on the 23d ult., for furnishing glass for the public building, at St. Louis, as follows: Semon, Bache & Co., of New York (for imported glass free of duty), $5,139; F. A. Drew, St. Louis, $7,175; N. J. De Paw, New Albany, Ind., $7,225; E. A. Boyd, New York, $7,411, and for imported glass, $4,880; William Glenny, Cincinnati, $7,850; London & Manchester Co., of New York, $8,235, for imported glass, $4,971; Drey & Kahn, St. Louis, $8,252; Heroy & Mariner, New York, $8,701, for imported glass, $5,441.

BRIDGES.

ORDERS have been presented to the Boston Board of Aldermen authorizing the city treasurer to borrow $400,000, to be expended in "rebuilding, relocating and widening Warren bridge and the avenues leading thereto."

THE PENN BRIDGE WORKS, Beaver Falls, Pa., are now engaged in manufacturing 24 spans iron bridges for the Pittsburgh, McKeesport & Youghiogheny R. R. They also have a considerable amount of bridging on hand for the Pittsburgh & Western R. R., as well as a large number of highway and city bridges. They have recently closed the following contracts: five bridges in Union County, N. J., as follows: for city of Rahway, one span 60 ft. with two 20 ft. roadways and two 10 ft. walks and one span 55 ft. with 30 ft. roadway and two 10 ft. walks; for village of Plainfield, one 45 ft. span with 22 ft roadway and two 7 ft. walks; for Clark Township, two 75 ft. spans, with 20 ft. roadway; also with city of Milwaukee, Wis., for two 130 ft. spans with 18 ft. roadway and two 6 ft. walks.

MISCELLANEOUS.

BIDS FOR STEAM-HEATING APPARATUS.—Bids were opened in the office of the Supervising Architect of the Treasury on Nov. 22 for steam-heating apparatus for the post-office and subtreasury at Boston, Mass., as follows: Walworth Manufacturing Company, $28,863; Q. M. Evans, $28,980; Nason Manufacturing Company, $30,250; Frederic Tudor, $30,600. The contract will be awarded to the Walworth Manufacturing Company.

PROPOSALS WANTED.—Gen. J. C. Duane, Engineer Third L. H. District, will receive proposals at the office of Light-House Engineer, Tompkinsville, Staten Island, N. Y., until Dec. 20, from iron manufacturers only, for the construction of the iron work of two light house towers and one pier. The towers and pier will be formed of cast-iron plates, bolted together. The towers will weigh about 60 tons each and the pier about 55 tons. Plans and specifications can be seen at the office of the Light-House Engineer.

TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

May 19, 1843, John R. Remington, of Alabama, invented a means of increasing the effective strength of timbers or beams used in bridges.

The nature of the device, so the inventor says, consists in so arranging the timbers as to avoid their tendency to break in the middle of their length, and this is effected by extending the ends of the timbers beyond the point of support, and there bracing or tying them down so as to render the points of support fulcra. The tendency to break is thus in part transferred to the points of support. Remington states that "it will be evident that thus supported the timbers cannot break in the middle without breaking also the two points of support."

The bridge is made to depend wholly upon the longitudinal sleepers *i i*. A cross-sill *b*, supported on piles *c c*, constitutes each pier. The extended ends of the sleepers beyond the piers are tied down by cross beams *g g*, and inclined braces *f f*.

This principle is intended to be applied under various modifications requiring either length or strength of timbers. Jointed piers may be used, so that the weight of the bridge shall tend to separate the piers at their upper ends, and thus

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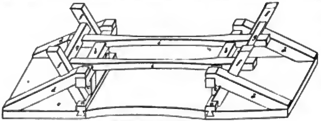
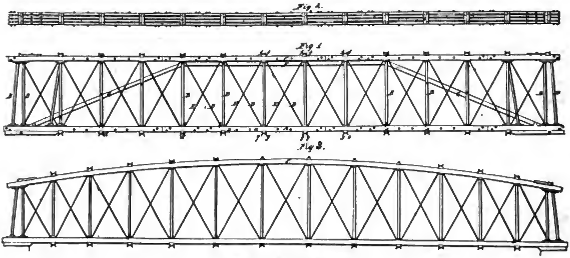
* Copyright, 1882.



Remington's Bridge.

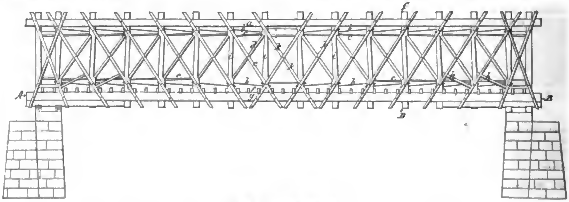
stretch the piers longitudinally. The bottoms of the piers are jointed so as to permit sufficient play for the purpose.

April 4, 1844, Thomas W. and Caleb Pratt received protection for a truss bridge, which protection was subsequently extended seven years from the 4th of April, 185-.



T. W. & C. Pratt's Bridge.

A represents the inferior or lower chord, composed of a number of timbers *a a* arranged side by side, and spliced and bolted. The posts *B B* are elevated upon this chord and rest upon the shoes *b*, which extend laterally across the chord, and notched into the same. Similar shoes *c c* are placed on the top of the posts to receive the superior chord *C*, which is constructed in the same manner as chord *A*. It may be arched, however, as seen in Fig. 3.



G. W. Thayer's Bridge.

The main braces *D D* and counter braces *E E* extend through the lower block *d d* under the posts through the upper blocks *e e* of the upper chord, where it is formed with a head *f*, its lower end having a screw and nut *g* to give it the required tension.

Where great strength is required a beam *F* is arranged directly under and in contact with the upper stringer, as seen in Fig. 1, and from each extremity of this beam an inclined beam *G* may extend to the lower string.

This system of bracing and counterbracing affords a means of regulating the camber of the bridge, and allows it to be drawn up or depressed in any particular segment, and thus furnishes a means of regulation not derivable from the then common single tension braces in each panel.

George W. Thayer, of Massachusetts, by letters patent, dated April 22, 1845, built a bridge of the appearance shown by the drawing.

a represents the upper chord, *b b* the chord bolts, *c c* are straining pieces interposed between the posts, *d d* are the principal diagonal braces stepped as shown by the drawing, *e e* are the counter braces, *f f* the floor beams, *g* the lower chord or string, and *h h* auxiliary braces.

Wooden trusses constructed generally like this bridge are all more or less subjected to settlement between their pieces or supports, by reason of the action of the peculiar strains exerted upon their chords in such manner as to draw apart from each other the timbers. This tendency is prevented by means of two series of iron screw-rods or bolts *b b*, the one being arranged directly under the upper chord and the other above the lower one.

If any sagging occurs between its points of support it may be overcome by screwing up the nuts of the iron rods *b b* The suspension pieces of the truss will thus be kept in their places and the chords prevented from drawing apart longitudinally.

(to be continued.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 411.)

CCCCXVIII.—LOS ANGELES, CAL.

Los Angeles, California, in lat 34° 3′ 10″ N., long. 118° 4′ 40″ W., on the Los Angeles River, is in a valley which is about a mile wide at the northern end where the river breaks through the hills, 100 to 309 ft. high, which diverge from that point and continue to the sea coast, 16 miles distant.

Settled in 1871, it was incorporated as a city in 1858. Water-works were begun by a private company in 1862 and improved in 1868.

The supply is taken from the Los Angeles River. A brush and sand wing-dam diverts the water into an open ditch excavated in earth, which conveys the water 7 miles to a reservoir formed by a masonry dam across a canon. It now holds 7,000,000 gallons, but its capacity is being increased to 10,000,000 gallons by excavating its bed to solid rock.

Distribution is by 26 miles of pipe, of from 22 to 1½ in. in diameter, with 60 fire hydrants, 200 gates and 1,726 taps. The city does not pay for hydrant service.

The distribution-pipes first used were of sheet-iron, cement lined. Many of these have failed, the asphalt-coating having been broken in laying. Where covered with cement, these pipes have not yielded. Pipes of No. 12 sheet-iron have been used, and also lap-welded boiler tubing. All extensions and repairs are now made with cast-iron pipe. For service pipes galvanized iron is used.

The population in 1880 was 11,311. It is now estimated to be 19,000. The daily consumption is 1,500,000 gallons. It sometimes is increased to 2,500,000 gallons in summer.

The capital stock of the company is $880,000. The works have cost $425,000. The bonded debt is $95,000 at 7 per cent. interest. No further financial statements are given.

Fred. Eaton, C. E., is the Engineer and Superintendent.

CCCCXIX.—GENESEO, ILL.

Geneseo, Illinois, in lat. 41° 20′ N., long. 90° 10′ W., is on level ground in an agricultural district.

Settled in 1837, it was incorporated as a town in 1855 and as a city in 1865.

Water-works were begun for the city by P. B. Perkins in 1879 and completed in September, 1882. The supply is taken from a well of 6-in. bore, 800 ft. deep. The principal yield is from a stratum 120 ft. below the surface. The water rises to within 25 ft. of the surface and is then pumped by a Dayton cam pump directly into the mains, with ordinary pressure of 20 lbs., and fire pressure of 60 to 80 lbs. A cistern holding about 80,000 gallons, under the pump house, is kept filled to be used in case of sudden demand.

Distribution is by 1,800 ft. of 6-in. cast-iron pipe, with 12 fire hydrants, 1 gate and 23 taps. Wrought-iron service pipes are used.

The population in 1880 was 4,080. The daily consumption is not known yet.

The works cost $7,000. The bonded debt is $4,000 at 6 per cent. The works were erected mainly for fire protection to the business part of the city.

The city council controls the works. Alexander White is the Superintendent.

CCCCXX.—NIAGARA FALLS, ONT.

Niagara Falls, Ontario, Canada, is on the east side of the Niagara River, below the Falls.

Settled in 1852, it was incorporated as a town in 1857. Water-works were built as a private enterprise in 1858 by Samuel Zimmerman, taking the supply from the Niagara River and lifting it 160 ft. by a double-acting piston pump, driven by a crank on the shaft of an overshot water-wheel 8 ft. in diameter. The wheel takes its water from a race supplied from the river. The water-level in the river fluctuates a good deal, and in winter the ice is very troublesome. Sometimes an easterly wind in winter keeps the water out of the race. The first pump ran for 21 years without reboring. The present one has been rebored after 7 years' use. The force main is of 6-in. cast-iron pipe, 2 miles long, and terminates in a stand-pipe in a reservoir, holding 1,500,000 gallons and lined with brick paving. The reservoir has broken away twice. There is another reservoir of 80,000 gallons. Distribution is by 3 miles of 6 and 3-in. cast-iron pipe, with 3 fire hydrants, 8 fire cisterns and 200 taps. The town pays $75 per year for hydrants. Service pipes are chiefly of wrought iron. The mains are now so arranged with a connection between the force and distributing-mains outside the reservoir, with check-valves, that water can be pumped directly into the mains without passing through the reservoir. The population is 2,500, and the daily consumption 90,000 gallons. The works have cost $100,000. The expenses of maintenance were $200 and the receipts $1,400 in 1881.

The works are owned by Lewis & Biggar, J. B. Lewis is the Manager,

CCCCXXI.—WALTON, N. Y.

Walton, New York, in lat. 42° 13′ N., long. 75° 5′ W. on the Delaware River, is in a valley about a mile wide, surrounded by abrupt hills from 400 to 800 ft. high. Three large brooks enter the valley from the North and unite with the Delaware River, which enters the village from the East and at its centre turns to the South.

Settled in 1784, it was incorporated in 1851. Water-works were built by a private company in 1879 after plans of William B. Rider, C. E., taking the supply from a stream draining 8 square miles, a mile and a half from the village. An impounding reservoir of 2½ acres area and 206 ft. above the village is formed by a dam across the stream 210 ft. long and 18 to 22 ft. high. The dam is of earth with inside slope of 2 to 1 and external slope of 1½ to 1, with a heart of dry rubble 12 ft. thick at bottom, and 5 ft. at top, backed with a 3 ft. wall of stone laid in cement. The lower face of the over-tail, 60 ft. long, is laid up with stone in steps of 1 ft. rise and breadth. The water is drawn from the reservoir through a chamber in the dam, 4 by 10 ft., and 18 ft. deep. The chamber is in these compartments, separated with wire screens. The first compartment, 6 ft. thick, is filled with charcoal, the second, 16 in. thick, with sponge. After passing through the charcoal and sponge the water enters the third compartment, 4 ft. by 2 ft. 8 in., whence it is conveyed to the village through 165 ft. of 10-in. and 8,814 ft. of 8-in. cast-iron pipe. The filter above described will pass 80,000 gallons per day.

Distribution is by 3.76 miles of cast-iron pipe of from .6 to 1¼-in. diameter with 22 fire hydrants, 21 gates and 90 taps. Service pipes are principally of enameled iron, with some of galvanized, some of plain iron and some of lead.

The population in 1880 was 1500. The daily consumption is 30,000 gallons.

The capital stock of the company is $15,000. The works have cost to the present time $17,500. There is no debt. The expenses of maintenance in 1881 were $25, and the receipts $1,000

Strong Comstock is President, and V. C. Wood, Secretary of the company, and John S. Ells, Superintendent.

CCCCXXII.—DAVENPORT, IA.

Davenport, Iowa, in lat. 41° 30′ N., long. 90° 34′ W., on the Mississippi River, is at the foot of and on the slope and top of a bluff rising to 180 ft. above low water. The rise of the river in high water is 18.75 ft.

Settled in 1836, it was incorporated as a city in 1839. Water-works were built in 1874 by Michael Donahue, by private enterprise, taking the supply from the Mississippi River.

A brick conduit, laid with Portland cement, 8½ by 3 feet inside, extends into the river and under its bed for 250 ft. from low-water mark. At the shore end is a well, 15 ft. in diameter and 30 ft. deep, from which the water is pumped directly into the mains, under 85 lbs. ordinary pressure and 110 to 140 lbs. fire pressure. For eight years the pumps were two horizontal piston pumps of 17 in. bore and 72 in. stroke, built by Todd & Rafferty, of Paterson, N. J., driven by gearing from two horizontal engines, with steam cylinders of 24 in. bore and 36 in. stroke, built by M. Donahue.

In 1882 the pumps were replaced by two Clapp & Jones' plunger pumps of 12 in. bore and 36 in. stroke, connected directly with the engine cylinders. These work satisfactorily.

Distribution is by 22 miles of cast-iron pipe of from 14 to 4 in. in diameter, with 251 fire hydrants, 65 gates and 780 taps. There are 178 meters in use. Each fire hydrant has a shut-off gate. The city pays $70 per year for each fire hydrant. This rate will continue until April, 1884. For the succeeding five years it will be $50 per hydrant. Galvanized iron service pipes are used.

The population in 1880 was 21,834, and the daily consumption was 1,700,000 gallons.

The capital stock of the company is $1,000,000. The works have cost $550,000. There is no bonded debt. No further financial statements are given. Michael Donahue is President and William Moffat Secretary of the company.

CCCCXXIII.—COLORADO SPRINGS.

Colorado Springs, Colorado, in lat. 38° 50′ N., long. 104° 49′ 8″ W., on Monument Creek, is on a level plateau 5 miles from the base of the Rocky Mountains.

Settled in 1871, it was incorporated in 1872.

Water-works were built in 1878 by the city after plans of W. B. Sherman, taking the supply from Ruxton's Creek, which is fed from springs and perpetual snow on the east slope of Pike's Peak. A dam across the stream, 7 miles from the city, diverts the water into a 10-in. cast-iron pipe, which conveys it 6 miles to a distributing reservoir, holding 2,000,000 gallons, which is formed by a dam across a small ravine; about 150 ft. above the city.

The main to the city is of 8-in. cast-iron pipe, and there are 11 miles of 6 and 4-in. distribution mains of cast iron, with 48 fire hydrants and 900 taps. Service-pipes are of wrought iron.

The population in 1880 was 5,000. The daily consumption is not known. A great deal of water is used for irrigation of lawns.

The cost of the works was $165,000, of which $25,000 was expended in relaying the mains which at first had not been placed deep enough, and consequently froze and burst.

The bonded debt is $99,000 at 7 per cent. interest. The expenses of maintenance in 1881 were $2,000 and the receipts $12,000.

The works are controlled by the water committee of three of the City Council. Morton Parsons is the Superintendent.

CCCCXXIV.—CHESHIRE, MASS.

Cheshire, Massachusetts, in lat. 42° 33′ N., long. 73° 11′ W. is at the head of one of the main branches of the Hoosac River, in a valley between high mountains. It was settled in 1867. The village is not incorporated. Water-works were built by a private company in 1875 after plans of William E. Pettee, C. E., taking the supply from Thunder Brook, 1 mile west of the village.

A stone masonry dam 40 ft. long and 12 ft. high across a rocky gorge, formed an impounding reservoir of about five-eighths of an acre area, at 200 to 280 ft. above the village. The water is drawn from the pond, through a chamber in the dam, 6 by 12 ft., in which are gravel and charcoal partitions, between wire screens. Distribution is by 5¼ miles of cast-iron pipes of from 8 to 3 in. diameter and 1½ miles of 2 in. wrought-iron pipe. There are 18 fire hydrants and 260 taps. The town does not pay for hydrants, but subscribed for $3,000 of the stock of the company. Service pipes are of wrought-iron. The mains are laid 6 ft. deep and covered with 1 ft. of charcoal braize to prevent freezing.

The consumption is not known, but is large in proportion to the size of the village, as a railroad company, two iron works, a sand company and a creamery are supplied. The population is 1,200.

The capital stock of the company is $15,000. The works have cost to the present time $17,800. The annual expenses are about $50 and the receipts $1,500. There is no debt.

R. A. Burget is the General Manager.

CCCCXV.—CANAAN, CONN.

Canaan, Connecticut, in lat. 42° 2′ N., long. 73° 20′ W., is 1 mile west of the Housatonic River on a sandy plain broken by limestone ridges rising from 10 to 100 ft. above its level. The town is 670 ft. above the sea.

It was settled in 1740.

Water-works were built in 1879 by a private company, after plans of William E. Pettee, C. E., taking the supply from a mountain spring 150 ft. above the village. A reservoir of half an acre area and is formed by a stone masonry dam 150 ft. long and 12 ft. high. The water is not filtered. A line of 6-in. and 4-in. cast-iron pipe convey it 1½ miles to the plain and then there is ¾ mile of 4-in. pipe through the main street. Branches of 2-in. and 1-in. pipe of 2 miles aggregate length have been laid by individuals and given to the company in consideration of free use of the water for terms of from 10 to 20 years. There are 6 fire hydrants and 150 taps. Service pipes are of wrought iron. The population is 700. The consumption is not known.

The capital stock of the company is $5,000. The works have cost $7,250. There is no debt. The annual expenses are $50 and the receipts $700.

Frederick Watson is the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks:

From E. B. Noyes and W. P. Jewett, statistics and water rates of Colorado Springs, Col., W. W.

From M. Scammell, Secretary and General Manager, statistics and water rates of Tiffin, O., W. W.

From J. B. Lewis, statistics and water rates of Niagara Falls, Ont., W. W.

From Alex. White, Superintendent, statistics and water rates of the Geneseo, Ill., W. W.

From Fred. Eaton, Engineer and Superintendent, statistics of Los Angeles, Cal., W. W.

From Strong Comstock, President Water Co., statistics of Walton, N. Y., W. W.

From M. Donahue, President, statistics of Davenport, Ia., Water-works.

From Isaac S. Cassin, C. E., statistics and water rates of Pottstown, Pa., Water-works.

From M. M. Tidd, C. E., statistics of water-works of Clinton, Mass.

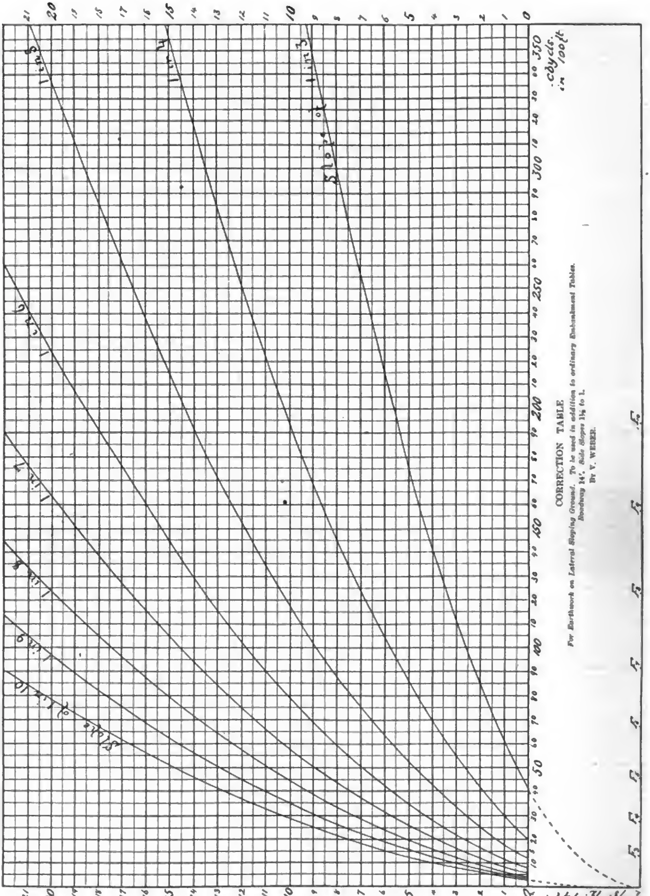
From Elbridge Howe, statistics of water-works of Marlborough, Mass.

From Carroll S. Page, statistics of water-works of Hyde Park, Vt.

From an unknown hand, description of the Gowen City, Dak., artesian well.

From D. C. Dixson, Controller, statistics of water-works of Saginaw, Mich.

A CITY OF MEXICO dispatch says that the Mexican Central Railroad has been completed to Lagos, thirty-seven miles north of Leon and 205 miles from that city. The National Railroad will be completed to Naravatio, 126 miles from there, on Dec. 5. Both extensions will be opened to the public about Dec. 10,



CORRECTION TABLE

For Earthwork on Lateral Sloping Ground. To be used in addition to ordinary Embankment Tables.

Roadway 14'. Side Slopes 1½ to 1.

BY V. WEBER.

Height of Embankment on Centre Line.

EARTH WORK CALCULATIONS.

EDITOR ENGINEERING NEWS:

The issue of Sept. 30 of your valuable paper contains a communication from Mr. Pellis concerning a method for the rapid calculation of earthwork. Before using said method, the cross sections must be plotted. But if the lateral slope of the ground is known, then it would save time, perhaps, by avoiding plotting, to use a graphical correction table in addition to ordinary earthwork tables. Such a correction table may easily be made according to the following principles:

Be *n* to 1 the lateral slope of the ground. Then the amount of earthwork given by an ordinary table for a given height *D M* of profile will correspond with a surface *E T V G*, which is less than the real surface of the cross section by the triangle *A E F*.

What is the relation between this triangle, *A E F*, and the height, *D M*?

Be *E H* the vertical height of *A E F*. Then we have:

$$\frac{AEF}{ACB}=\frac{EH^2}{CM^2}, \text{ or } \frac{AEF}{AEF+ECG}=\frac{EH^2}{CM^2}, \text{ or again,}$$

$$AEF.\ CM^2=(AEF+ECG)EH^2;\ AEF(CM^2-EH^2)=ECG.\ EH^2.$$

hence,

$$AEF=\frac{ECG.\ EH^2}{CM^2-EH^2}$$

But in case of side slopes of 1½ to 1 we have triangle

$$ECG=\frac{3}{2}CM^2,$$

also,

$$EM=\frac{3}{2}CM$$

and

$$EH=\frac{1}{n}EM=\frac{3}{2n}CM.$$

We have therefore

$$AEF=\frac{\frac{3}{2}CM^2.\left(\frac{3}{2n}CM\right)^2}{CM^2-\left(\frac{3}{2n}CM\right)^2}$$

or lastly,

$$AEF=\frac{\frac{3}{2}CM^2}{\left(\frac{2n}{3}\right)^2-1}$$

For a given slope *n* to 1, the last equation represents a parabola with the different heights *C M* as ordinates, and the corresponding surfaces *A E F* as abscissas. And the surface *A E F* has only to be multiplied by 100 and divided by 27, to give the number of cubic yards to be added to the number of cubic yards given by the ordinary tables for a height *D M = C M − C D*.

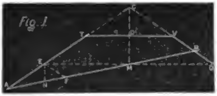


Fig. 1

Practically the correction table can best be plotted in the following way:

We calculate

$$AEF\times\frac{100}{27}$$

for a given height *C M* in feet and a given lateral slope of *n* to 1, and mark the number of cubic yards thus obtained to a convenient scale on axis *A B*, *A M* from *A*, the latter point being the apex of the parabola. *C M* will be the ordinate at *M*. We draw now *A E* at right angles with *A B*, through apex *A*, and making

$$AD=\tfrac{1}{2}CM,$$

have in *D C* a tangent to the curve at *C*.

FG, at right angles with *CD*, through *D*, will mark at *F*, on *AB*, the focus, and at *G*, on a parallel line to *AB*, through *C*, a point of the directrix *GH*. The abscissa for another height, *C'M'*, as ordinale, can now easily be found by making *IH*, on *GH* prolonged, equal *C'M'*, join *I* with *F* and draw through the intersection *K* with *EA*, at right angles with *IF*, het line *KL* to the point *L* of intersection with a parallel line to *AB* through *I*. *L* is then a point of our parabola *KL*, tangent to the curve at *L*; *LN = IH = C'M'*, the chosen ordinate, and *AN* the abscissa, representing the number of cubic yards to be added for a height of profile

$$h = LN - CD.$$

A few points with their tangents thus plotted will be sufficient for drawing the curve.

The same way will lead to other parabolas answering to other slopes.

In order to enter the correction table with the height of profile *D M* (see fig. 1), instead of *C M*, we only have to measure the ordinates *DM* from a line parallel to the axis common to all the parabolas, and at a distance equal *DC* above it.

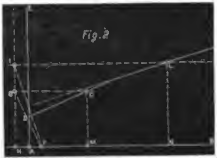


Fig. 2

For a grade width of 14 ft. and side-slopes of 1½ to 1, we get

$$DC=\tfrac{2}{3}.\tfrac{14}{2}=4\tfrac{2}{3}\text{ ft.}$$

For any other width at grade we keep the same curves, and only move accordingly the line parallel to the axis. Yours respectfully,

V. WEBER, C. P. R.

WINNIPEG, Oct. 15, 1882.

BOOKS RECEIVED.

THE RAILROAD SPIRAL; or, the Theory of the Compound Transition Curve Reduced to Practical Formulæ, and Rules for Application in Field Work: with Complete Tables of Deflections and Ordinates for 500 Spirals. By Wm. H. Searles, C. E., M. A. Soc. C. E., author of Field Engineering. New York: John Wiley & Sons. 1882. Price, $1.50.

The author says in his preface that "the object of this work is to reduce the well-known theory of the cubic parabola, a multiform compound curve, used as a transition curve, to a practical and convenient form for ordinary field work." The book is for engineers. "The method described is that of transit and chain, analogous to the method of running circular curves; it is as simple in practice and as accurate in results." The book comprises eighty-five pages, and the notation followed is that of "Field Engineering." It is of convenient size for the pocket, and is substantially bound in morocco.

ANNUAL REPORT of the Chief of Engineers U. S. A., for the year ending June 30, 1882.

ANNUAL REPORT of the Chief Engineer of the Water Department of the City of Philadelphia for the year 1881.

THE N. Y. W. S. & B. RAILWAY, the new double track Direct Trunk Line between New York City and the Great Lakes; a pamphlet giving a statement of the affairs of the above railway, and submitted for the purpose of furnishing full and accurate information regarding the character and progress of the enterprise and the business upon which its prospects are based. Accompanied by an excellent map of N. Y. State, showing the location of the line. To be had at the office of the company, 15 Broad street, N. Y.

TEST OF BUILDING MATERIAL made at the Watertown arsenal, Mass., August, 1882, by the U. S. Ordnance Department, at the request of the Commissioners for the Erection of the Public Buildings in the city of Philadelphia, Pa., chiefly in reference to the material used in the New City Hall. With the compliments of Isaac S. Cassin, Commissioner.

JOURNAL OF THE ASSOCIATION OF THE ENGINEERING SOCIETIES for October. Contents: Chicago Cable Roads; the Smoke Nuisance; Steel Methods and Manufacture; a Flying Ferry in Washington Territory; Proceedings. Can be had by addressing H. G. Prout, 12 Barclay street, N. Y. 30 cents per number.

THE BUILDERS' GUIDE AND ESTIMATORS' PRICE BOOK being a compilation of current prices of lumber, hardware, glass, plumbers' supplies, paints, slates, stones, limes, cements, bricks, tin and other building materials; also prices of labor and cost of performing the several kinds of work required in building. Together with prices of doors, frames, sashes, stairs, mouldings, newels and other machine work. To which is appended a large number of building rules, data, tables and useful memoranda, with a glossary of architectural and building terms. By Fred T. Hodgson, editor of *The Builder and Wood Worker*, New York. The Industrial Publication Co., 1882. Price, $2.

This is a reference book especially intended for building contractors.

ANNUAL REPORT OF THE COMMISSIONER OF PATENTS for the year 1881.

From the Institution of Civil Engineers. Abstracts of papers in Foreign Transactions and Periodicals. Vol. LXX, Lesson 1881-82, Part IV. Boult and Potts in Seacombe Ferry Improvement Works. Harvey on Coal Washing.

CORRESPONDENCE.

THE LONGEST RAILROAD TANGENT.

GREENSBORO, N. C., Dec. 1, 1882.

EDITOR ENGINEERING NEWS:

Will some of your numerous readers give length of the *longest tangent* on an operating railroad both in this country and Europe, and the name of road? Yours truly, R. P. A.

CONVENTIONAL COLORS.

PITTSBURGH, Pa., Dec. 4, 1882.

EDITOR ENGINEERING NEWS:

Referring to L. E. Vel's query in ENGINEERING NEWS of date of Oct. 28, "regarding the use of *colors* for the various lines of a railroad survey," I would say that in my practice, extending over a number of years, I have generally used the following:

For preliminary lines, *black*.
" location lines, *red*.
" changed or altered lines, *blue*.
" contours, *green*.
" property lines, dotted lines, shaded with *light red*.

Ground lines of profiles, *black*; and the grade lines, *red*. Respectfully, TRANSIT.

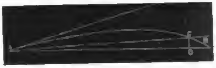
SPIRAL CURVES.

MANKATO, Minn. 21, 1882.

EDITOR ENGINEERING NEWS:

I would like to present a few arguments sustaining Mr. Reaugh in criticising the spiral curve as described in your issue No. 10 of this year.

Referring to the accompanying figure *acb* represents the spiral in question. *A* = sta. 20; *b* = sta. 21 and *c* = sta. 20 × 90. Ordinate, *cd* = *ac* × *tan. cab* = 90 × *tan.* 12 = 31.



Now if Mr. Fry goes to *b* (sta. 21) and deflects 51½ from the long chord *ab* his telescope will *not* be tangent to the spiral for this reason: *Tan.* 51½' × 6*d* (or 10) = 15; which is less than the ordinate *cd*.

In other words the line of sight passes within the point on curve *c*. A. M. HAYNES.

LIFE OF A LOCOMOTIVE BOILER.

A locomotive boiler, it is calculated, will last until the engine has travelled over 350,000 miles. On some lines, however, the boiler, under favorable circumstances, particularly when pure water is used, may travel 400,000 or 500,000 miles before becoming unserviceable. Assuming that the life of the engine is determined by the endurance of the boiler, and that if under favorable circumstances it will last the 500,000 miles, then during that time it is estimated that the fire-box will probably require to be renewed at least three times, the tires of the wheels five or perhaps six times, the crank-axles three or four times, and the tubes from seven to ten times.—*Exchange*

FOND DU LAC, WISCONSIN, has no water-works. The inhabitants are supplied from artesian wells, varying in depth from 75 to 400 ft. The well holes and cisterns furnish a supply for fire purposes.

Contracts for cedar-block pavement in Toronto were let recently. The prices bid were: For pavement per square yard, 90 cents to $1.18, and for curbing per lineal foot, 23 to 27 cents.

Diagram of Average Heights

Corresponding to the true prismoidal content from a la

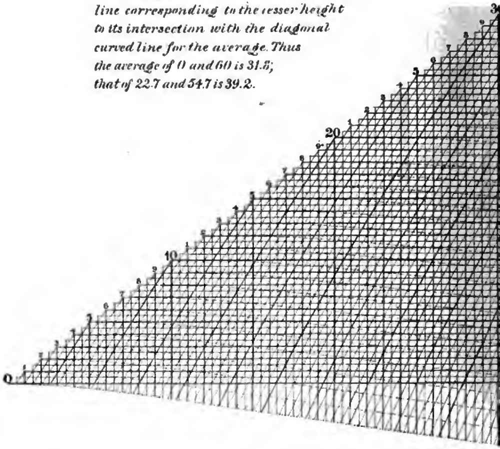
Formation 32 – 1½ to 1.

This diagram will serve for other double track formations in and fill, being a little in deficiency for less widths at grade with width at grade with flatter slope; and a little in excess for grea with same slope, or same width at grade with steeper slope· Var small to represent on diagram without confusion of lines.

Instructions.

For earthwork, follow the horizontal line corresponding to the lesse height to its intersection with the diagonal curved line corresponding to the greater height; the point of intersection marks the average height. Thus the average of 0 and 60 is 33.5; that of 18.3 and 45.5 is 32.7

For rock cuts, 26 – ¼ to 1, follow the dotted line corresponding to the lesser height to its intersection with the diagonal curved line for the average. Thus the average of 0 and 60 is 31.8; that of 22.7 and 54.7 is 39.2.



of level sections.

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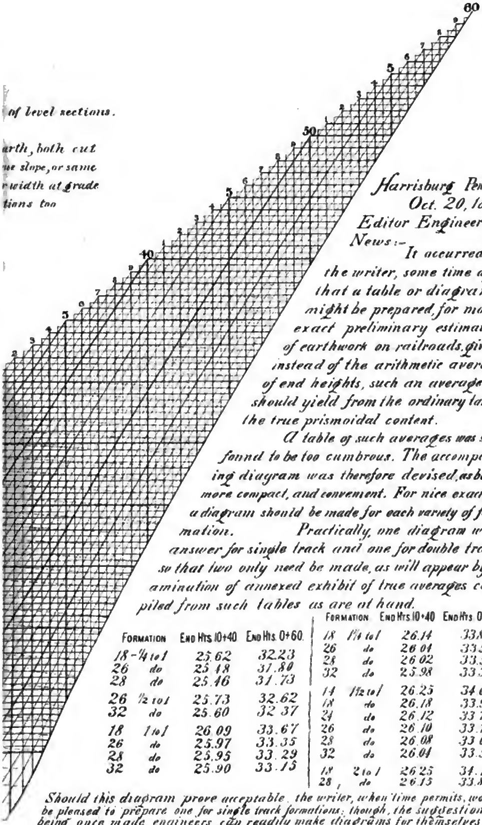

Harrisburg Penna.
Oct. 20, 1882.

Editor Engineering News:– It occurred to the writer, some time ago that a table or diagram might be prepared, for more exact preliminary estimation of earthwork on railroads, giving, instead of the arithmetic average of end heights, such an average as should yield from the ordinary tables the true prismoidal content.

A table of such averages was soon found to be too cumbrous. The accompanying diagram was therefore devised, as being more compact, and convenient. For nice exactness, a diagram should be made for each variety of formation. Practically, one diagram will answer for single track and one for double track, so that two only need be made, as will appear by examination of annexed exhibit of true averages compiled from such tables as are at hand.

FORMATION		END HTS 10+40	END HTS. 0+60.
18	– ¼ to 1	25.62	32.23
26	do	25.48	31.80
28	do	25.46	31.73
26	½ to 1	25.73	32.62
32	do	25.60	32.37
18	1 to 1	26.09	33.67
26	do	25.97	33.35
28	do	25.95	33.29
32	do	25.90	33.15

FORMATION		END HTS 10+40	END HTS. 0+60.
18	1¼ to 1	26.14	33.84
26	do	26.04	33.56
28	do	26.02	33.50
32	do	25.98	33.37
14	1½ to 1	26.25	34.09
18	do	26.18	33.95
24	do	26.12	33.76
26	do	26.10	33.70
28	do	26.08	33.64
32	do	26.04	33.53
18	2 to 1	26.25	34.10
28	do	26.15	33.85

Should this diagram prove acceptable, the writer, when time permits, would be pleased to prepare one for single track formations; though, the suggestion being once made, engineers can readily make diagrams for themselves, to such scales as they may prefer.

Yours respectfully,
Wm. F. Shunk.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR.............ASSOCIATE EDITOR.

SATURDAY, DECEMBER 9, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance, for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
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Van Nostrand's Magazine	4.00	5.00
North American Review	4.00	5.00
Sanitary Engineer	2.75	3.00
Railroad Gazette (new subs.)	3.50	4.20
" " (renewals)	3.90	4.20
American Architect	5.00	6.00
Scientific American	2.65	3.20
Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do this we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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SHUNK'S AVERAGE HEIGHTS.—This valuable table which we publish to-day can be had on thick paper, at the price of twenty-five cents each, or five for one dollar.

OUR CLUBBING RATES.—We will send magazines or other periodicals subscribed for through us to *any address*. Our *subscribers* may send us the orders of their friends at our clubbing rates. We wish it to be especially noted that the Harpers do not give receipts; the sending of the publication subscribed for is considered as proof of receipt of money. Subscribers must not expect to receive their papers or magazines by return mail, but they ought to have them within a reasonable time according to distance from the office of publication; in case of non-arrival of magazine, or of the wrong one, write *direct to the office of publication*, specifying that it was subscribed and paid for through ENGINEERING NEWS; this is a busy season of the year in magazine and newspaper offices, and it takes time and care to clear off all orders rapidly and without a single mistake.

Special notice is called to the offer of the Weales' Series, *free*, advertised on another page. There are numbers which we do not expect any person will give shelf room to, but there are many valuable books in the list which are certainly worth the postage on them.

HOLIDAY BOOKS, ETC.—We have peculiar advantages for accommodating our subscribers at this holiday season of the year. The stores of this city are now overflowing with goods for holiday presents. To oblige our subscribers we will supply them with books from the catalogue of *any* publisher *during the present month only*, at a *discount of 20 per cent.* off retail rates. To this must be added postage at the rate of six cents on the dollar. Parties ordering must be subscribers to ENGINEERING NEWS.

ENGINEER'S BOOK OF TABLES.—We made a mistake in saying last week that these tables were calculated at Newburgh. They were calculated in the offices at Little Falls and this city; they were all checked over in the New York office and arranged for publication. We have already received orders for a large proportion of the present edition, which orders will be filled at once on receipt of the books from the office of *The Graphic* on Monday next.

TRIANGULATION STATIONS.

The fifth annual report of progress of the New York State Survey, lately issued, gives a description of the methods adopted for preserving and marking the trigonometrical stations. Wherever practicable an underground center mark, in the shape of a glazed earthen-ware pot, is planted, which bears upon its base the letters N. Y. S. S., and has a small hole in the center of the base to mark the precise center of the station. The depth of this earthen-crock below the surface of the ground is about four feet. Above it is set a granite monument four feet long and six inches square, weighing about one hundred and eighty pounds, which projects about six inches above the surface. The letters N. Y. and S. S. are cut on two of the sides of this monument and the number of the station on another, while on the top diagonal lines are drawn whose intersection is vertically over the center mark. As an additional security two reference pots are planted at a distance of three feet from the station center, and one and one-half feet below the surface of the ground with arrows upon them pointing to the center. This method of marking must, of course, be modified when rock is struck near the surface. Then the center and reference points may be replaced by copper bolts, or rarely a center bolt may be put at the surface of the rock and the monument at one side where there is a sufficient depth of soil. In all cases careful notes of distances end directions to surrounding objects are taken, to enable the station to be discovered in future years.

The seventh annual report of the survey of the Adirondack region of New York shows also that the subject of monuments has received careful attention. In rock, copper bolts were used; in soil, heavy stone monuments with drill hole centers; and in a special instance a bowlder of quartzite weighing nearly a quarter of a ton was rolled to the spot and into it a nickel-plated copper bolt securely fastened with melted lead, while on the granite rocks around were carved deep sunken arrows pointing to the center.

The requisites for an underground mark, as stated in an article in the Report of the United States Coast Survey for 1868, are indestructibility, peculiarity, capacity to resist displacement in case it should be accidentally struck, cheapness, and want of value for any of the ordinary purposes of life as a protection against cupidity. For a surface mark or monument the requisites are permanency, durability, facility with which it can be recognized, and the absence of value for any domestic or farm purposes. To meet these requirements various forms of stoneware cones, blocks, bolts and monuments, depending upon the nature of the ground, have been devised and used.

There is another element that should receive careful consideration whenever the station is liable to be often visited; namely, the danger arising from human curiosity. There exists, it is true, in all countries and among all conditions of men, a certain degree of respect for a monument or landmark, due partly to ancient precepts and habits, and partly to the fact that the laws impose penalties for the malicious disturbance of property bounds and corners. But the element of curiosity seems often to be more powerful than that of respect. Surveyors who have planted monuments with underground marks, and have allowed the facts concerning the buried pot or crock to become known in the neighborhood, have often been surprised at the degree of curiosity manifested by boys and young men in the matter. The belief seems to prevail that the crock contains something rare or valuable, or it is supposed that there is some other object planted below the crock concerning which the truth has not been told. And not infrequently it happens that the boys actually excavate the earth, pull out the earthen pot, and finding nothing else, dash it to pieces in their disappointment.

The gnawing tooth of time causes the works of man to slowly decay and disappear from the earth, but the destruction effected by man, himself, is often the greatest. A stone monument might stand for centuries upon a hill if only nature's force acted upon it. But the plow cuts the earth away, and the boy delighted to dig for the buried crock. A copper bolt, and particularly a nickel plated one, stands little chance of remaining many years, if left projecting, or out of the rock. The preservation of the station is thus seen to be a difficult matter, yet much can be done in that direction if only the destructive force be recognized in advance.

Perhaps the most obvious plan to ensure the future recovery of the station would be to multiply the number of reference points around it. Holes may be drilled in rocks or bowlders and their distances and directions from the center of the station be carefully measured. Several monuments may be set at different distances from the central one. And instead of a single stoneware pot below the monument two or more might be buried at different depths. But to prevent the destructive effects of the curiosity of the boys it seems necessary that some of these operations should be conducted in secrecy. If the underground crocks, both for the center and for the reference monuments be buried by the surveyor and his assistants, without help from the people of the neighborhood, and if no tradition be left regarding them, it is probable that the stone monument will be properly respected and remain long unmolested.

THE PHILADELPHIA WATER-WORKS.

The letter of Secretary Murphy, of the Philadelphia Engineers' Club, led to a little ripple of excitement at the meeting of the club on last Saturday evening, and the outcome was the following resolution:

"Whereas, A letter over the signature of an official of this club, and addressed to a political organization, has recently appeared in the newspapers of this city, recommending certain parties as candidates for the position of head of one of the city departments, which letter, from the way in which it was published and commented upon, has been extensively received as being the action, or having the endorsement of this club.

"Resolved, That this club deem it proper to announce, while not intending to interfere with the personal action of any of its members; that it has no desire or intention to interfere in any way with political subjects; that it it is not responsible for the above-named letter, nor for similar publications which may appear; and that the sole object and province of this club as expressed in its constitution is: 'The professional improvement of its members; the encouragement of social intercourse among men of practical science, and the advancement of engineering in its several branches.'

"Resolved, That a copy of this preamble and resolution be furnished to the several newspapers of this city with a request to publish the same."

Mr. Murphy, in defence, called attention to the fact that he did not sign the letter as secretary of the club, nor did he date it from the club rooms.

At a conference meeting of members of the Se-

TABLE SHOWING COMPARATIVE COST OF MAINTENANCE OF PHILADELPHIA WATER-WORKS FROM 1861 TO 1881.

	McFadden.			Graff.	Birkinbine.	Cassin.	Birkinbine.
	1881.	1878 to 1881.	1873 to 1881.	1867 to 1872.	1864 to 1866.	1862 and 1863.	1858 to 1861.
	1 Year.	4 Years.	9 Years.	6 Years.	3 Years.	2 Years.	4 Years.
Yearly average in mill. galls. pumped 100 ft. with water power	7.575	7.766	8.174	7.971	6.925	4.576	3.448
" " " " " steam power	26.673	22.938	17.814	6.902	4.785	5.516	4.937
" " " " Total	34.248	30.704	25.988	14.873	11.710	10.092	8.385
Per cent. by water	22 per cent.	26 per cent.	31.4	53.6	59	45.3	41.1
Per cent. by steam	78 per cent.	74 per cent.	68.6	46.4	41	54.7	58.9
Total yearly average cost of pumping, distribution and maintenance	$299,560.68	$253,728.58	$272,578.32	$180,283.77	$169,471.26	$108,645.79	$82,874.86
Cost per million gallons	8.74	8.35	10.47	12.12	14.47	10.77	9.88
Average height to which the water was lifted	151 ft.	148 ft.	146 ft.	118 ft.	113 ft.	116 ft.	115 ft.
Per cent. by steam power	78 per cent.	74 per cent.	68.6	46.4	41	54.7	58.9
Yearly average in millions of gallons consumed and pumped into basins at the lifts as given	22.721	20.709	18.000	12.534	10.338	8.716	7.267
Cost of maintenance per million of gallons distributed	$13.18	$12.25	$15.14	$14.36	$10.39	$12.46	$11.40

lect and Common Councils of Philadelphia, held behind closed doors on last Friday afternoon (1st inst.), Mr. Clay offered a resolution declaring that, in the opinion of the members of Councils there assembled, the interest of the city would be best subserved by the election of new men as the heads of the Departments of Highways, Water and Markets and City Property.

In the matter of the Water Department: "I have yet to hear," said Mr. Hollingsworth, "that the evidence that was produced in the Belmont investigation or at any other time has cast suspicion upon the integrity of Chief Engineer McFadden. For his competency the results of his administration should best speak. I know that the cost per gallon of pumping and distributing the water is, to-day, less by far than under any preceding chief engineer, and that the expenditures of every branch of the department have been decreased in proportion." The resolution passed in the three cases.

A resolution was then adopted requesting the Franklin Institute to present the names of six engineers, suitable candidates for Chief of the Water Department, three of them to be not members of the Institute.

We publish herewith a table showing comparative cost of maintenance of the Philadelphia Water-Works for the last 20 years. It will be observed that, with the same machinery, an enormous increase of plant to care for, better water service, increased average head of pumpage, and the proportion of the cheaper power (water) decreasing, yet the *total* cost of maintenance decreases per million gallons distributed. Evidently some councilmen wish a new deal of offices, and while they do not expect to get a better administration of the Water Department than at present, yet they have friends who *must* be fed at the public crib.

PERSONAL.

A. H. Keating, M. Inst. C. E., Chief Engineer of the City of Halifax, N. S., was at the meeting of the American Society of Civil Engineers, on Wednesday Evening. Mr. **Keating** is visiting the New York and Philadelphia dry-dock yards, with a view to contemplated improvements in Halifax.

Henry C. Murphy, President of the Board of Trustees of the East River Bridge, died at his residence in Brooklyn, on the 1st inst. Mr. Murphy was born in Brooklyn in 1810. He graduated from Columbia College in 1830; was admitted to the bar in 1833; was elected Mayor of Brooklyn in 1842, and before his term expired was elected to Congress. In 1857 he was appointed Minister to the Hague. He drafted the first bill for the construction of the East River Bridge, and it was mainly due to his efforts that the bridge was built.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

At a regular meeting, held on Dec. 6, Vice-President Paine in the chair, the following were elected members: Timothy Cookson Bradley, Assistant U. S. Engineer, St. Joseph, Mo.; Henry J. Gielow, Assistant U. S. Engineer, Town Creek, Ala.; Edward S. Safford, Division Engineer, New York, West Shore & Buffalo, and New York, Ontario & Western railroads, Newburgh, N. Y.; James Dix Schuyler, Chief Engineer and General Superintendent, Sinaloa & Durango Railroad, Culiacan, Sinaloa, Mexico; Thomas Wellington Spencer, Civil Engineer, Utica, N. Y.; Russell Thayer, Chief Engineer and Superintendent, Fairmount Park, Philadelphia, Pa.; Edmund Brownell Weston, Engineer in charge Water Department, Providence, R. I.

Mr. J. J. R. Croes, M. Am. Soc. C. E., described the progress that had been made in the procuring of supplies of water for cities and towns from subterranean sources, or "ground water," describing and illustrating the galleries, basins and wells which have been constructed in the United States within the last 18 years. The theory on which the first works of the kind were constructed was that a supply could be procured by filtration through the gravel of a bank of a river or pond. It was found, however, that more water came from the land side than the river, and that it was of a different character from the river water. It is now established that such supplies are furnished almost exclusively from the great underground streams or reservoirs, which are found in all the valleys of streams which are filled to a considerable depth with gravel. The failures and successes of many works were described, and the yield of filtering galleries discussed. The relative advantages of open and closed galleries were discussed, and it was shown that the experience of most places was decidedly against the advisability of open galleries or canals, on account of the growth of vegetation in them, although the water came from the gravel perfectly pure and cold, like spring water. An interesting discussion followed, in which Gen. George S. Greene, Mr. Joseph P. Davis, Mr. F. H. Keating, City Engineer of Halifax, and others participated.

LIVERPOOL ENGINEERING SOCIETY.

At the usual fortnightly meeting of the above Society held on Wednesday evening, 22d inst., at the Royal Institution, Colquitt st., Mr. N. Bramhall, Vice-President, in the chair, a paper was read by Mr. W. E. Mills, entitled "Notes on the Mallett System of Controlled Combustion." The author in introducing his subject stated that the question of dealing with the cloud of smoke hanging over our large cities, and the immense waste of heat which its presence testified to, had been attempted in many ways from time to time. All engineers were familiar with the different kinds of smoke consumers and fuel economizers which were before the public, but none of which altogether achieved the end aimed at, viz., the consumption of the smoke generated by the fuel in the furnace. Mr. Mallett, of Denver, Colorado, U. S. A., who had studied the subject, saw that the difficulty with all the smoke consumers was the impossibility of entirely burning all the atoms of carbon set free in the act of combustion. He conceived the idea, that if by any means the fuel could be burnt in such a manner as not to produce any smoke at all, and so preserve all the heat which would be otherwise wasted, a great step would be gained. He effected this in the following manner: A combustion chamber is fitted behind the boiler furnace, communicating with it by a perforated septum wall. The fire-bars were made hollow, and so arranged that cold air from the exterior could pass through them into the combustion chamber. The open ends of these firebars could be closed by a slide, worked by a lever, which also actuated the apertures in the ash-pit doors. When coal was first put on the fire, the latter openings were closed. The gases given off from the fuel passed into the combustion chamber through the apertures in the septum wall, and meeting there with the oxygen conveyed through the fire-bars were entirely consumed. The inventor claims that, by his method no smoke being produced, all chimneys may be done away with, and a saving of about forty-five per cent. in fuel effected. The necessary draught is provided by a fan which draws the heated gases, the ultimate products of combustion, through a condenser in which they are cooled down, and then discharged into the open air. The application of the system to stationary marine and locomotive boilers was next described, with the various scientific principles involved.

A discussion followed, and a vote of thanks was accorded to the author.

GENERAL INTELLIGENCE.

We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.

GAS AND WATER.

The Department of Public Works of this city have received the following bids for furnishing the city's buildings with gas for the coming year: New York Gas Company, $1.50 per 1,000 ft., 18-candle power; Manhattan Gas Company, $1.50, 16-candle power; Harlem Gas Company, $2.25, 16-candle power; Metropolitan Gas Company, $1.50, 20 to 23-candle power; Municipal Gas Company, $1.75, 25-candle power.

The system of water supply for North Borough, Mass., is completed and has cost $52,000.

ELECTRICITY.

A Cable Project.—Toronto, Nov. 29.—The Great Northwestern Telegraph Company has elected Erastus Wiman, of New York, President, and appointed a committee to consider the project of laying a cable in Lake Superior.

Pennsylvania has chartered the Postal Telegraph Company. The line is to run across the State from Wayne to Erie counties.

The Empire Electric Light Company, of New York, has been incorporated; capital, $100,000.

The Electric Light is about to be introduced at Allentown, Pa.

A New Telegraph Company.—Articles of incorporation of the New York & Pennsylvania Telephone and Telegraph Company were filed in the office of the clerk of this county. The new company is to construct, own and maintain a line or lines of electric telegraph between this city and Erie, Pa., the principal cities on the route being Elmira and Binghamton. Its capital stock is now $50,000, but this may be increased to $1,000,000.

The Postal Telegraph Company, now engaged in putting up its lines between New York City and Chicago, has its poles all planted with the exception of 15 miles between Honesdale and Narrowsburg, and 150 miles of the line west of Cleveland, O.

RAILROADS.

Ground has been broken at Eagle Pass, Tex., for the Mexican Pacific extension on Mexican soil.

A Railway Exposition.—The *Chicago Railway Age* announces that arrangements have been completed for a great national exposition of railway appliances to be held in Chicago in June, 1883.

New Road.—A movement is on foot at Shreveport, La., to organize a company to construct a narrow-gauge railway from Shreveport to a point in Arkansas, connecting with the Paramore system.

A dispatch from Hartford, Conn., states: A party of civil engineers, who have been at work in the vicinity of Meriden and who have evaded questions as to the purpose of their labor, are now said to be in the employ of the Delaware & Lackawanna Company, and to be surveying for a railroad between Springfield and New York parallel to the New York, New Haven & Hartford road.

The route of the Manitoba, Pembina & Grand Forks Railroad, which has been incorporated, begins from a point on the international boundary line between the United States of America and the Dominion of Canada, not more than three miles west of the Red River of the North to the city of Grand Forks, Dak. It will be constructed as near as practicable to the western banks of the Red River of the North, and between the Red River and the present constructed line of the St. Paul, Minneapolis and Manitoba Railroad. The estimated length of said railroad is eighty miles, and is to run through the counties of Pembina, Wabash and a portion of Grand Forks. The capital stock of the corporation, $1,000,000.

Track Changed.—The track of the Pittsburgh & Western Railroad was changed on Sunday from narrow to standard gauge. The road is nearly fifty miles long, and the work was done in fifteen hours.

The Paramore narrow-gauge system is completed from Cairo, Illinois, to Gatesville, Texas, with the exception of a gap in the White River Valley, which is to be closed this month.

Mexican Subsidies.—City of Mexico, Dec. 4.—In an editorial which it is understood reflects the opinion of the Mexican Government, the *Two Republics* says: "While the Government is desirous to settle the English debt, it will not assume any burden which may prevent it from meeting its engagements with American and Mexican railroad companies.

New Illinois Road.—Articles of incorporation have been filed by a new railroad, starting from Springfield and running to some point in Jackson County.

THE ST. LOUIS & TEXAS narrow gauge road has now 800 cars running with straight tread wheels, and it is claimed that they run more easily than the coned wheels and with at least equal safety.

ROAD FOR SALE.—WILMINGTON, Del., Nov. 28.—The Dorchester & Delaware Railroad, 37 miles long, connecting Seaford, Delaware and Cambridge, Md., was offered at public sale at Cambridge this morning. Only $29,000 being bid the road was withdrawn.

THE CANADIAN PACIFIC railway has raised its capital from $15,000,000 to $100,000,000.

THE New York Elevated Railroad Company sent to Mayor Grace a copy of the Court of Appeals' decision in the case of Rufus Story against the company, and the following remarks signed by Vice President Galloway: "Inasmuch as the company acquired its right to such use and occupancy of certain streets as is necessary to railway service, for a compensation in money, under a contract between it and the city which declared that the payment thereof shall be the legal compensation in full, for the use and occupancy of the streets, by said railway, as provided by law, it now calls upon the city to defend the rights of the company under this contract. If it shall be compelled to make compensation to abutting owners for its use and occupancy of the streets, it will claim that the compensation should be paid by the city. With this view it invites the city to take part in the defence of the company against suits for such compensation; and respectfully gives notice that whatever it may be compelled to pay it will reclaim from the city." The Mayor sent the letter to the Corporation Counsel, with instructions to protect the city against the claims of the company, if he finds them not well founded.

TEXAS RAILROAD NOTES.—Progress on the Southern Pacific Railroad in Texas is very slow. It is thought a junction will be formed, and through trains will be in operation not before January 1. The construction gangs are now in the centre of a wild, mountainous country, and the survey of the road leads across deep cañons and through high mountains, or makes sharp cuts around them. The locality is about 225 miles from San Antonio. The track-layers are only a few miles apart. The northern party is 407½ miles from the bridge across the Rio Grande, near El Paso. Travel is fair on the Atlantic & Pacific road from Mojave to Calico. Work on the road is going forward rapidly. Track-layers and graders are out about 55 miles east of Calico Station. A dispatch from San Antonio states that Capt. W. S. Monroe has been awarded the contract for grading, track-laying, bridging, etc., for 100 miles into Mexico by the Mexican Pacific Construction Company, composed of Col. Huntington, Crocker, Pierce, and others. C. P. Huntington has purchased the Rio Grande and Pecos Railway, now being built through the rich coal-fields between Laredo and Eagle Pass.

TO BE DOUBLE-TRACKED.—It is authoritatively stated that the Naugatuck Railroad, between Waterbury and Bridgeport, Conn., will have a double track next spring. The road-bed will be prepared at once.

A PENNSYLVANIA ROAD.—It is expected that work on the Conewago Valley Railroad will be resumed vigorously at an early day. It is now completed as far as Redsecker's mill.

RAILROAD COMPLETED.—The Kansas City, Fort Scott & Gulf Railroad is completed to Van Buren and Fort Smith, Ark.

CONTRACTS LET.

THE contract for slating and galvanizing the public building at Charlestown, W. Va., has been awarded to Knisely Brothers & Miller, of Chicago, and for the heating apparatus of the Paducah building to Bartlett, Hayward & Co., of Baltimore.

BUILDING.

A COURT HOUSE, to cost $40,000, is in course of erection in Breckenridge, Minn.

NEW GOVERNMENT BUILDINGS.—The government has accepted deeds of ground for a new custom-house and post-office building at Council Bluffs, Ia.

BRIDGES.

A NEW BRIDGE is to be erected over Flushing Creek Long Island.

THE bridge across the Arkansas River at Arkansas City is almost completed.

PROPOSED NEW BRIDGE IN VIRGINIA.—The Board of Supervisors of Stafford County met in Falmouth recently and made an order authorizing the issue of $20,000 in county bonds for the purpose of building a free bridge across the Rappahannock, at Fredericksburg; bonds to be registered to date from Jan. 1, 1883, and bear six per cent. interest, payable semi-annually.

THE BOSTON BOARD OF ALDERMEN on the 4th inst. passed an order authorizing the borrowing of $400,000 to be expended in the relocation and widening of Warren Bridge.

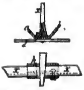
MISCELLANEOUS.

MILL STOPPED.—The managers of the North Chicago Rolling Mill Company state that their mill in North Chicago, which recently shut down, will probably never be opened again for the purpose of rolling steel rails, but will be devoted to other classes of iron work. All the steel rail work will be done hereafter in the mills in South Chicago.

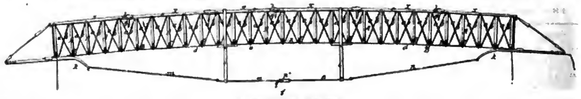
TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

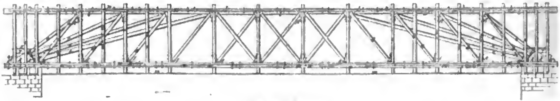


DETAILS OF RIDER'S BRIDGE.



RIDER'S TRUSS BRIDGE.

November 6, 1845, Nathaniel Rider, of Massachusetts, devised a truss bridge, shown by the drawings, in which *A* denotes the posts arranged upon the sills *B*. Each sill is supported by two iron tension braces, *a b*, united beneath the sill, and diverge therefrom upwardly. The tension bar *b* of each panel is connected at the top of a post to the bar *a* of the panel adjacent. Another chord or stringer of plate iron, *d*, extends beneath the sills and the tension braces, and is bolted to the sills. A wedge, *e*, is placed between the foot of each post and the sill. By driving in the wedge, the post will be elevated and the tension braces of each of the bars *a b* of any two panels equally strained. The tension braces and chords are made of wide plate iron.



HASSARD'S BRIDGE.

A device for cambering the bridge is shown. A series of wedges, *g*, are interposed between the adjacent sections of the upper chord bars *x*, which have lapping socket bands *h*.

Iron posts, *i r*, extend below the chord *d*. To the lower strings also are applied two bent bars, *k k*. A cambering chain, *m n o p*, passes under the posts *i r*, which are provided with friction rollers, and is secured to the bars *k k*. It will be seen that when the bridge is cambered or sprung upwardly by means of the cambering chains, provision is also made for the distension of the upper chord. The bars *k* admit of endwise movement of the abutments when the bridge is elevated.

January 15, 1846, Thomas Hassard, of New York, patented a railroad truss-bridge. His object was to provide a means for compensating for any shrinkage of the parts connected with the inclined braces, which he effects by introducing wedges through a shoe at the foot of each brace; and secondly, the manner of combining the arch pieces with the structure, so as to give equal strains to all the parts of the bridge.

The chords *a* consists of three strings, each composed of three tiers of timber. Between these three strings are introduced the posts *c*. Bolts *n* pass through the chords by the side of each post, and provide means for removing the post should occasion require. The upper chord *b* has but two tiers of timber, and is otherwise constructed like the lower chord. At the foot of each post are placed cast iron shoes, *A* having side flanges *f*, and bottom flanges. These shoes take the feet of the braces *d* and the heads into metal caps *A'*.

An abutting block, *k*, is placed above the pin or abutment, back of which is placed a sustaining block, 4. A ledge piece, *r*, and stay bolt *s*, complete the connection of these parts. The block *k* has a series of steps, 3 3, which receive the ends of the arch braces *e e*, which extend in diagonals successively rising above each other, until each terminates at its top in contact with an intermediate string piece in contact with the upper chord timbers.

(TO BE CONTINUED.)

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* Copyright, 1882.

CORRESPONDENCE.

SHIP BUILDING.

FERRYSBURG, Mich., Dec. 7, 1882.

EDITOR ENGINEERING NEWS:

I am glad to see that the subject of vessel building has found its way into your journal, but I am sorry to find Mr. Hang, or the printer considerably off, in almost the first paper. See "Engineering Societies," page 411, of ENGINEERING NEWS for Dec. 2, 1882.

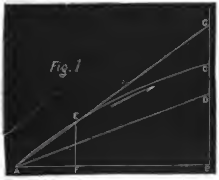
In the fourth paragraph we read of "Extreme Proportions," whatever that may mean. I suppose it is of a class with "magnificent proportions," "huge proportions," "immense proportions," "stupendous proportions," "enormous proportions," etc. All of which terms we see at times in the papers, but as Webster nor the mathematicians give us any information concerning them I am at a loss to understand what is meant by "extreme proportions."

In the same paragraph, he gives us the length of the vessel in terms of "depth." The length of the vessel is generally given in terms of the breadth, called "beams." If he had said the vessel was over 11 beams in length, he would have been nearer the mark. In the same paragraph, too, he tells us about strengthening the vessel in the top and bottom members by "doubling strokes." If he had reference to the fore and aft courses of plank or plates, he should have used "strakes."

But further, along, we find "stemports" in connection with "rudders," "stems," etc. What does "stemports" mean?

NEGATIVE SLIP.—I see, too, by other journals, that the ghost of "Negative Slip," of propeller wheels, is still tolerated, and even professors of engineering presume to explain it and tell us how such a thing can be. This absurd idea comes from the fact that engineers have not yet learned how, or rather where to measure the pitch of a wheel blade. This statement may be deemed a broad assertion, but it is too true, as I will try to show satisfactorily. And in my efforts, where so many others have failed, to lay this ghost, perhaps I may be excused for being a little elementary.

We may premise that this property of "Negative Slip," so called, is peculiar to that class of wheels, having a "gaining pitch," *i. e.*, one in which the angle of pitch increases from the leading to the trailing or following edge of the blade.



Conceive the blades of the wheel to be intersected by a cylinder whose axis is concentric with the center of the shaft. And let the curve *A. C.* (Fig. 1) be the developed intersection of the same, with the concave or working face of the blade. Then, drawing *A B* at right angles with the shaft, and *B C* parallel with the same, we have in *B C* the mean pitch (so called) corresponding to the width of the blade. *B C* is also the length of wheel, and *A C* is the width of blade, the point *C* being in the leading edge, and the point *A* in the trailing edge of the same.

From *C* set down *C D* equal to the slip, and join *A D*. Then in the line *A D* we have what may be called the *the line of motion*, for any point in the curve *A C* moves in a helix, which, when developed on a plane, is strictly parallel with this line.

When this curve is properly designed or adapted to the pitch of the blade, the tangent of the curve at *C* will be parallel to the line *A D*, in which case the initial pressure of the blade at this point will be zero. The intensity of the pressure will increase from *C* to *A*, where it will be at its maximum, for at this latter point the inclination of the blade to its "line of motion" is also at its maximum. But the motion for all points in this curve being the same, the work done at any point will be as the intensity. That is to say, the work done by any elementary helecoidal area, whose section is represented by the curve *A C*, may be represented by the area of a triangle, whose base is at *A* and vertex at *C*.

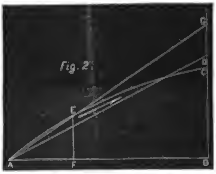
But the pitch is to be measured at the center of gravity of the work done. Moreover, the center of gravity of the area of a triangle is at one-third of the height of the triangle from the base. Whence, *we are to measure the pitch at one-third of the distance (measuring along the curve) from A to C.* That is to say, take the arc *A E* one-third of *A C*, and through *E* draw the secant *A C*, intersecting *B C* produced in *C*. Then is *B C* the actual working pitch, corresponding to the width of the blade; it is this pitch that determines the motion of the vessel; and *B C*, which is generally called the actual mean pitch, *is only a part of the same.* *B C*, too, has been called the full slip, but it is now seen to be only part of the same.

If it should be desired to find the pitch of the whole wheel from that corresponding to one of the blades, we must bear in mind that the line *A B* is the developed arc of the circumference corresponding to the width *A C* of the blade. Then dividing *A B* by 3.1416, the ratio of circumference to diameter, we shall have the corresponding diameter; and dividing *B C* or *B G* by this diameter, we have the *nominal* pitch, or the *actual* pitch, as the case may be. Or by formula,

$BC + \overline{AB + 3.14} =$ the *nominal*, or so called mean pitch, in terms of the diameter, and

$BG + \overline{AB + 3.14} =$ the *actual* or *working* pitch in terms of the diameter. "Negative Slip" will never make its appearance with this pitch.

In the case of what is called "Negative Slip," "the line of motion," *A D*, runs *forward*, off and across the curve of the blade, as in (Fig. 2). This comes from giving *too much curvature* to the blade. The difference between the pitch of the forward edge of the blade and that of the after edge is made too great, causing the tangent of the curve at *C* to run *behind* the line of motion, *A D*. By this means, the forward part of the blade does *negative* work, and the useful work is thrown upon the after portion of the blade, which thus propels the vessel *in spite* of the forward part.



It has been thought that wheels showing the property of "Negative Slip," so-called, were very desirable, but it is an erroneous conclusion. Indeed, they are to be avoided as we would shun any other wasteful agent. For, besides the direct loss of power in the negative work of the forward portion of the blade, we find undue loss in the after portion, from the increased obliquity at the point where useful work is done. Moreover, such wheels are unnecessarily wide, thereby absorbing a vast amount of power in useless friction and disturbance of the water.

Many other serious mistakes, entertained by eminent engineers, and promulgated by the bookmakers could be enumerated, but this paper is already too long.

H. C. PEARSONS,
U. S. Inspector of Steam Vessels.

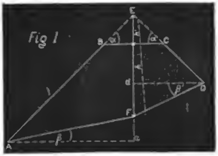
EARTHWORK CALCULATIONS.

SOUTH PENNA. R. R.,
SOMERSET, Pa., Dec. 12, 1882.

EDITOR ENGINEERING NEWS:

In several numbers of your paper I found more or less practical communications about rapid calculations of earthwork. In some methods the cross-sections must be plotted, in others diagrams are proposed. As in many cases the estimates are made by the party in the field, the carrying of the least papers possible is desirable.

In "Winkler's Vorträge über Eisenbahnbau," I found some very practical formulæ entirely based upon calculation, and I suppose not generally known in America. Fig. 1 represents the cross-section of an embankment.



h = center height.

h' = height of triangle BEC.

α = slope angle of embankment.

β and β' slope angles of the ground right and left from center stake.

$$ABCD = \triangle AEF + \triangle EFD - \triangle BEC.$$

$$\triangle AEF = \tfrac{1}{2}(h + h') \times Aa.$$

$$\triangle EFD = \tfrac{1}{2}(h + h') \times Dd.$$

$$Aa = (h + h' + Fa)\cot.\alpha \quad Dd = (h + h' - Fd)\cot.\alpha.$$

$$Fa = Aa\tan.\beta \qquad Fd = Dd\tan.\beta'.$$

$$\text{Thus, } Aa = \frac{h + h'}{\tan.\alpha - \tan.\beta'} \quad Dd = \frac{h + h'}{\tan.\alpha + \tan.\beta'}$$

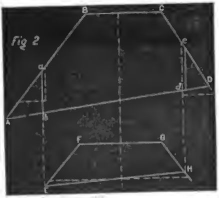
$$\text{and } \triangle ABF = \frac{(h + h')^2}{2(\tan.\alpha - \tan.\beta')}$$

$$\triangle EFD = \frac{(h + h')^2}{2(\tan.\alpha + \tan.\beta')}$$

In these formulæ h', α and $\triangle BEC$ are constant for each formation. We remark that for an embankment α + slope gives α + tangent and α — slope α — tangent.

Excavations considered as reversed embankments, we must also reverse the signs of the transverse slope of the ground.

In embankment α — transverse slope of the ground augments the area, thus divider in the formula must diminish, in consequence the tangent β negative; in excavation α — transverse slope of the ground diminishes the area, thus divider must increase and tangent positive.



Correction in quantities:

In your number of Dec. 9, Mr. Shunk gives a very valuable diagram for those who are in possession of other diagrams and tables, reducing transverse ground slopes to level cuttings. But for those who follow the method of calculating, the following method gives a very close result. The prismoidal content between the sections $ABCD$ and $EFGH$, distance l, is equal to:

$$\left(\frac{ABCD + EFGH}{2} - \frac{Aab + cdD}{6}\right)l$$

Generally for calculating quantities from the areas of the cross-sections, only the first part of the formula is taken. We get then too large quantities which must be diminished by $\frac{A\ a\ b + c\ d\ D}{6} \times l.$

In plotting the cross-sections along the same axis, those triangles are easily calculated, but also without plotting we come to a very close result in neglecting the transverse slopes of the ground and considering the sections a trapezoid with center-height as height.

For two sections with center heights h and h' and slope formation n we get for

$\frac{A\ a\ b + c\ d\ D}{6}\ l$ the expression $\frac{(h-h')^2}{6}\ nl.$

As a comparison we have calculated an embankment for 100 ft. length, 24 ft. roadway, 1½ slope; transverse ground slope 10°, center heights at the end 10 and 80 ft., and get: By using Trautwine's diagram and tables, 4,317 c. yds.; by using Trautwine and Shunk's diagram of average heights, 4,512 c. yds.; by using our formula, 4,532 c. yds.; by calculating the quantities from the end-section without correction, 4,922 c. yds.

Yours respectfully,

E. Thiange, C. E.

DIFFICULT EARTHWORK MEASUREMENTS.

Ulster County Division,
New York, West Shore & Buffalo Railway,
Marlborough, N. Y., Dec. 8.

Editor Engineering News:

In my article of Nov. 11 explaining manner of taking measurements on rock work under difficult conditions, I see I am taken severely to task in your issue of Dec. 2, by Mr. J. C. Isaaci, assistant engineer on the Yellowstone Division, of the Northern Pacific Railroad, for allowing a contractor to work a cut in such a manner as to break back of the original section and he shows in his article how *he does* and would work a rock cut, viz.: In horizontal courses, and by using a templet commence at the slope stake and work therefrom to grade. This manner of working a cut will answer very well where conditions are the same as on Isaaci's cut on the Yellowstone, viz.: soft sandstone intermixed with clay; where he can define the "geological strata for classification" as his work proceeds. But there is a vast difference between chalk and cheese, and between soft sandstone and a mixture of clay, worked with a pick, a little powder, and a shovel, and limestone and slate rock, classified by the Creator as *very solid* rock, and worked entirely by drilling and high explosives, as along the Hudson River.

An old engineer just returned from the Yellowstone Division, who has been on that work for nearly two years, in answer to an inquiry, writes me as follows:

"In some cases the bluffs were worked with a horizontal base from the top, but very seldom. The slope originally was ¼ and in some cases ½ to 1, and was set back because it would not stand at that slope to ½—⅝—¾, and in some cases 1 to 1. The rock is a very soft sandstone and in one stratum of lignite and indurated clay, and the slopes can be very easily worked with picks, and that it is possible to get a very uniform slope. Considerable power is used."

Mr. Isaaci says a contractor should receive the most severe censure for creating gouges back of original section. Does censuring his contractors on the Yellowstone make the material stand at ¼ to 1. He must have sworn loud at ¾ and damned outrageously when it had to go back to 1 to 1. Would the latter not be a big gouge back of the original slope stake? If the wisdom and long-sightedness of some gouge engineers had, perhaps, been coupled with that of the Great Supreme Architect thousands of years ago, we should have had all of our rock laid in strata standing at ¼ to 1, to accommodate railway building, and not stand at all angles, as He has seen fit to place it, necessitating great gouges and set-back of slope.

Come East, Mr. Isaaci, and study how the rocks lie in their native beds on the Hudson River, and have templets cut at all angles for them.

R. Smith Henry,
Asst. Engr. Ulster Co. Division.

LONGEST TANGENT.

Editor Engineering News:

In reply to query as to the longest tangent, I would say that there is one on the Camden & Atlantic R. R., in New Jersey., about 32 miles, and one on the Northern Pacific, from Fargo, west through Dakota, about 60 miles in length.

L. M. H.,
University of Pennsylvania.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page 419.*)

CCCCXXVI.—SAGINAW CITY.

Saginaw City, Michigan, in lat. 43° 25′ 1″ W., long. 83° 57′ 8″ W., is on level ground on the Saginaw River.

Settled in 1822, it was incorporated as a city in 1857. Water-works were built in 1873 by the city after plans of the Holly Manufacturing Company, taking the supply from the Saginaw River and pumping directly into the mains by four piston pumps of 9 in. bore and 24-in. stroke, and two 10-in rotary pumps for fire pressure, driven by a Holly steam engine. The ordinary pressure is 45 and the fire pressure 95 lbs.

Distribution is by 2.4 miles of cast-iron and 6.6 miles of Wyckoff wooden pipe, of from 16 to 4 in. diameter, with 133 fire hydrants, 33 gates and 325 taps. Service pipes of lead and of iron are used. The population in 1880 was 10,525. The daily consumption is 1,000,000 gallons.

The works have cost $175,000. The bonded debt is $150,000 at 8 per cent. interest. The expenses in 1881 were $10,067.19, and the receipts, $3,500.

The works are managed by a Board of Commissioners.

D. C. Dixson is the Superintendent.

CCCCXXVII.—TIFFIN, O.

Tiffin, Ohio, in lat. 41° 10′ N., long. 84° 15′ W., is on level ground on both sides of the Sandusky River. Settled about 1810, it was incorporated as a city in 1850. Water-works were built in 1879 for a private company by the Wiley Construction Company, taking the supply from the Sandusky River and pumping directly into the mains by four piston pumps, driven by a 72-in. turbine under 8 ft. head. A dam, 280 ft. long, furnishes the water-power. There are also two direct acting steam pumps for use when water is low.

The ordinary pressure maintained is 50 lbs. and the fire pressure 80 to 150 lbs.

Distribution is by 15 miles of pipe of from 16 to 4 in. diameter, chiefly of cast iron, with some wrought iron. The pump works are on the north side of the river, a mile above the centre of the city. The river is crossed by a 16-in. main at the pump house, and a 12-in. pipe near the centre of the city. A 16-in. main is laid down the south shore and a 10-in. main down the north shore.

There are 102 fire hydrants, 50 gates and 400 taps. The city pays $90 per year each for 98 hydrants and $75 per year for each additional one. Service pipes are of wrought iron.

The population in 1880 was 7,875. The daily consumption is 278,000 gallons.

No financial statements are given. Walter Burnham is President of the company, and M. Scammel, Secretary and General Manager.

CCCCXXVIII.—RICHMOND FURNACE.

Richmond Furnace, Massachusetts, in lat. 42° 22′ N., long. 73° 28′ W., is on both sides of Centre Brook on irregular ground, generally sloping to the west for a mile to Stockbridge Ponds, which are 760 ft. above sea level.

The town was settled in 1760. The village is not incorporated.

Water-works were built by the Richmond Iron Works in 1882, after plans of William E. Petee, C. E., taking the supply from Centre Brook, which is fed by the Richmond swamps, 1,170 ft. above sea level and 1½ mile above the point at which the water is taken. A dam 100 ft. long and 8 ft. high, of stone masonry, forms a reservoir of ½ acre area. A chamber 6 by 12 ft. in the dam, is filled with gravel and charcoal layers between wire screens. Through these the water is filtered and enters a 6-in. cast-iron main leading to the village, 4,000 ft., with a fall of 53 ft. and a rise of 40 ft. at a summit on the route. The reservoir is about 20 ft. above the tops of the highest houses in the village. There is also ½ mile each of 3-in. cast and 2-in. wrought-iron pipe, the extreme head on which is 90 ft. Water is furnished to the company's shops and stables, the railroad station and 50 houses owned by the company. R. A. Berget is the General Manager of the company's works.

CCCCXXIX.—LAS VEGAS.

Las Vegas, New Mexico, in lat. 35° 35′ N., long. 105° 20′ W., on the Gallinas River is in the middle of a broad valley, 12 miles long at the foot of the Rocky Mountains.

Settled in 1844, it was incorporated as a city in 1882.

Water-works were built in 1882, for a private company, by Russell and Alexander, taking the supply from the Gallinas River which receives the drainage of 24 square miles of mountains.

A dam of timber, stone and clay, 6 miles from and 350 ft. above the city, impounds the water of the stream. There is on the shore, a crib 6 ft. wide, filled with stone and sand, through which the water passes to a well, whence it is conveyed through 100 ft. of 12-in pipe to a series of settling reservoirs in 6 compartments, 100 by 25 ft. Cast-iron pipe 10 in. and 8 in. in diameter lead to the city.

Distribution is by 12 miles of cast-iron pipe of from 8 to 4 in. diameter with 30 fire hydrants and 300 taps. The city pays $2,400 per year for use of hydrants. Service pipes are reported as of cast-iron.

The population is reported as 6,000 in 1882.

The capital stock of the company is $200,000. The works have cost $110,000. The expenses in 1882 have been at the rate of $3,000 per annum and the receipts at the rate of $9,000 per annum.

L. P. Brown is the President and W. S. Smith the Superintendent.

CCCCXXX.—WALLA WALLA.

Walla Walla, Washington Territory, in lat. 46° 5′ N., long. 118° 22′ W., is on Mill Creek in Walla Walla Valley, nearly surrounded by the Blue Mountains.

Settled in 1857, it was incorporated in 1862. Water-works were built by a private company in 1865, taking the supply from springs, the water from which is collected in two reservoirs holding about 240,000 gallons each.

Distribution was at first by wooden pipe, for which riveted wrought-iron pipe has since been substituted. There are 8 miles in use, of from 10 to 3 in. diameter, with 20 gates and 250 taps. There are no fire hydrants. Service pipes are of wrought-iron. The population in 1880 was 3,500. The consumption is not known.

The capital stock of the company is $150,000. The works have cost $100,000. The bonded debt is $55,000. The expenses in 1881 were $1,800. The receipts are not given. J. C. Isaacs is Secretary and J. F. Bowman the Superintendent.

CCCCXXXI.—HYDE PARK, VT.

Hyde Park, Vermont, in lat. 44° 36′ N., long. 72° 40′ W., is on irregular ground on the Lamoille River, which furnishes an important water-power.

It was settled in 1790; but the village has never been incorporated. Water-works were built by a private company in 1850, after plans of S. Niles, taking the supply from springs, the water from which is conveyed to and through the village by 5 miles of lead pipe of 1 in. and ½ in. diameter. There are 50 taps and no fire hydrants. Lead service pipes are used. The population in 1880 was 1800. The consumption is not known.

The capital stock is $2,400, mostly owned by the water takers. The works have cost about $3,000. The annual expenses and receipts are $200.

Carroll S. Page is Secretary and Treasurer, and A. P. Smalley General Manager.

CCCCXXXII.—MARION, IND.

Marion, Indiana, in lat. 39° 42′ N., long. 86° 30′ W., is on level ground on the Mississinewa River.

Water-works were built by the city in 1877 after plans of J. D. Cook, C. E., taking the supply from a well 25 ft. in diameter. The brick curb, built on a timber shoe, was sunk 26 ft. into a stratum of saturated porous gravel, by excavating from the inside. A pipe was then driven 42 ft. through hard pan into another water-bearing stratum, the water from which will rise 16 ft. above the surface of the ground.

The water is pumped directly into the mains by a Dean duplex steam pump with 18 in. steam and 10 in. water cylinders, of 14 in. stroke.

The ordinary pressure is 30 lbs., and fire pressure 80 lbs. There are 6 miles of cast-iron pipe of from 12 to 4 in. diameter, with 44 fire hydrants and 26 gates. The number of taps is not given. Service pipes are of galvanized iron.

The population in 1880 was 4,000. The daily consumption is not furnished.

The works cost $25,000. The bonded debt is $30,000. Further financial statistics are not given.

The works are managed by a Board of 3 trustees, Samuel Hulley is the Superintendent and B. R. Norman Clerk to the Board.

CCCCXXXIII.—THOMASTON.

Thomaston, Connecticut, in lat. 41° 40′ N., long. 73° 5′ W., is on irregular ground. Originally part of the town of Plymouth, it was set off in 1875 and named after the founder of the village, Seth Thomas, the clock manufacturer.

Water-works were built by a private company in 1880, after plans of W. B. Rider, C. E., taking the supply from a small stream, which receives the drainage of about 2 square miles. A dam 512 ft. long, built of earth with a rubble masonry heart-wall, forms a storage reservoir of 37½ acres area, holding 60,000,000 gallons, at 318 ft. above the village, and 1¼ miles from it. A filter chamber is constructed in the dam with sponge and charcoal, but is not entirely satisfactory.

A 10-in. cast-iron pipe conveys the water to the village, and the distribution is by 5 miles of cast-iron pipe from 12 to 4-in. diameter, and 1 mile of wrought-iron of 2 in. and 1 in. There are 33 fire hydrants, 28 gates and 140 taps. The town pays $600 per year for use of hydrants. Service pipes are of galvanized iron.

The population in 1880 was 2800. The consumption is not known.

The capital stock of the company is $30,000. The works have cost $39,000. No further financial statements are given.

W. T. Woodruff is Secretary and Treasurer and Nelson Bennett, Superintendent.

CCCCXXXIV.—ABILENE, KAN.

Abilene, Kansas, in lat. 38° 52' N., long. 97° 20' W., is on level ground on Smoky Hill River.

It was settled in 1868. Water-works were built in 1882, by a private company, after plans of Mr. C. Orton, taking the supply from a well 20 ft. in diameter and 40 ft. deep, in porous saturated gravel. The water is pumped directly into the mains by a Gaskill duplex engine of 1,000,000 gallons capacity, constructed by the Holly Manufacturing Co. The ordinary pressure is 30 lbs. and the fire pressure 80 lbs.

Distribution is by 1 mile of cast-iron pipes of 10, 8 and 6 in. diameter, with 17 fire hydrants and 4 gates. The number of taps is not given. The town pays $100 per year for each hydrant. Service pipes of lead and of iron are used.

The population in 1880 was 2,700. The daily consumption is not known yet.

The capital stock of the company is $30,000. The works have cost $25,000. The bonded debt is $25,000. The expenses have so far been at the rate of $1,680 and the receipts $2,700 per year. J. E. Bonebrake is President and Superintendent.

CCCCXXXV.—ITHACA, N. Y.

Ithaca, New York, in lat. 42° 30' N., long. 76° 30' W., in a valley at the head of Cayuga Lake, surrounded on three sides by hills from 400 to 1,000 ft. high, is built partly on the flat and partly on the hillsides. It is the seat of Cornell University. Settled in 1789, it was incorporated in 1821. water-works were built by a private company in 1872, after plans of Isaac S. Cassin, C. E., taking the supply from Buttermilk Falls Creek, which has a watershed of 10 square miles.

At 3 miles from the village, and 500 ft. above it, a dam of cribs of white pine timber, filled in with small stones, grouted with cement forms an impounding reservoir holding 10,000,000 gallons. The water from this flows down the bed of the stream for one mile to another and similar dam, 212 ft. above the village, where 1,500,000 gallons are impounded. Some of the higher parts of the village are supplied directly from this reservoir. The main supply is conveyed 2 miles by an 8-in. cast-iron pipe to the distributing reservoir, which is 146 ft. above the village and holds 1,350,000 gallons. It is on a side hill, on rock foundation, and built of stone masonry, laid in cement, lined with brick and backed on the outside with earth, supported by a stone retaining wall. The bottom is covered with 18 to 24 in. of concrete.

Distribution is by 10 miles of cast-iron pipe of from 20 to 4 in. diameter, with 35 fire hydrants and 115 gates. The number of taps is not given. The village pays $75 per year for each hydrant. Service pipes are of lead and of galvanized iron, the latter being principally used now.

The population in 1880 was 9,140. The daily consumption is not given.

The capital stock of the company is $100,000. The works have cost $156,000. The bonded debt is $56,000 at 6 per cent. No further financial statistics are given.

Leonard Treman is President and E. M. Treman Secretary.

CCCCXXXVI.—PARKDALE, ONT.

Parkdale, Ontario, Canada, in lat. 43° 39' N., long. 79° 23' W. is on ground gently sloping to the shore of Humber Bay, Lake Ontario. It was incorporated as a village in 1879. Water-works were built by the village after plans of Walter P. Horon, in 1881-82, going into operation in March. The supply is taken from Lake Ontario. A double crib of 12-in. timbers, 40 ft. square outside and 20 ft. inside, with the intervening 8 ft. filled with gravel, is sunk in the lake in 16 ft. water. The water is taken from the interior well of the crib through a 12-in cast-iron suction pipe 687 ft. long, on the lake bottom, with flexible joints, to the pump house, whence it is pumped directly into the mains by a Perkins pump of 8-in. water and 14-in. steam cylinders, of 12-in. stroke. Its nominal daily capacity is 2,000,000 gallons. The ordinary pressure is 75 lbs. and fire pressure 115 lbs. at the pumps. The highest ground in the village is 87 ft. above the lake.

Distribution is by 7.6 miles of cast-iron pipe of 10 to 4 in. diameter, with 55 fire hydrants and 47 gates. The number of taps is not given. Service pipes are of lead.

The population is 1,100, and the daily consumption 55,000 gallons.

The works have cost $49,000. The bonded debt is at 6 per cent. interest. The receipts for 1882 were $900; expenses not given.

John Patrick is the Superintendent.

CCCCXXXVII.—LONGMONT, COL.

Longmont, Colorado, in lat. 40° N. long. 105° W., on the St. Vrain River, is on undulating ground, with a gentle slope to the eastward. Settled in 1870, it was incorporated as a town in 1873. Water-works were built in 1882, by the town, after plans of Daniel Ransom, taking the supply from the St. Vrain River, which receives the drainage of the Rocky Mountains and the base of Pike's Peak.

A well is sunk on the river bank, 9 miles from the town. From the well an 8-in. pipe is laid for a few feet, and from this a filter culvert is laid under the bed of the stream. It is a stone box culvert, 2 ft. wide and 1 ft. high, covered with 2 ft. of sand and gravel. From the well the water is conveyed 8 miles in a 6-in. wrought-iron pipe to a reservoir or cistern, in excavation with brick walls and floor, holding 665,000 gallons at 112 ft. above the town.

Distribution is by 4 miles of special light wrought-iron pipe of 8 in. to 3 in. diameter, with 26 fire hydrants and 50 gates. The number of taps and the daily consumption can not be given yet. Service pipes are of galvanized iron.

The population in 1880 was 800, and in 1882 was 1,200. The works have cost $65,000. The bonded debt is $20,000 at 8 per cent. interest.

The works are managed by the trustees of the town.

CCCCXXXVIII.—WESTERN N. C. INSANE ASYLUM.

The Western North Carolina Insane Asylum has been in course of construction since 1876, near Morgantown, in lat. 35° 43' N., long. 81° 40' W.

The water supply was provided for in 1876 by works built after the plans and under the superintendence of Roger P. Atkinson, C. E., the engineer of the Asylum. The supply is procured from Black Fox Branch, a tributary of the Catawba River, 4.7 miles from the institution.

Across a gorge in the mountains a dam 60 ft. long and 8 ft. high was built of coursed rubble masonry, on a footing of concrete 2 ft. thick and 2 ft. below the bed of the stream. The dam is backed with heavy rip-rap. Earth embankments extend the dam at each end. From a chamber in the dam, 3 ft. square, one 6-in. pipe is laid into the reservoir, and another 6-in. pipe conveys the water to the Institution. The pipes are of cast-iron. The storage reservoir holds 100,000 gallons, at 175.5 ft. above the Asylum.

The pipe was laid following the undulations of the surface, but nowhere rising above the hydraulic grade line. Air cocks are placed at summits and blow offs at depressions. The lowest point is 200 ft. below the reservoir. The pipe trenches were only 2½ ft. deep ordinarily. No sleeve connections were made, but closings were made by springing in the pipe. There were 3 lbs. of lead and $\frac{3}{16}$ lbs. oakum used per joint. Except on very steep hillsides the trenches were kept open until the pipe was completed and tested under a head of water. The conditions under which this work was executed, in a wild and remote region, render the details of its cost of interest. Common labor was had for 60 and 75 cents per day and skilled labor for $1.50 to $3. The most economical distribution of labor in laying the pipe was as follows:

1 man in front making rests for end of pipe.
3 men handling and laying pipe in place in trench.
2 men calking oakum.
1 man preparing oakum in rolls.
2 men rolling and preparing clay.
1 man putting clay on joints.
1 man taking off clay.
2 men melting lead.
2 men calking lead joints.
1 man cutting off projecting lead.

16 men in all, who would, after the pipe was distributed alongside of trench, lay 120 to 150 pipe, 12 ft. long, in 10 hours.

The distribution of the pipe along the line, with an average haul of 6 miles, cost $1.73 per 2,000 lbs.

The minimum daily yield of the stream is 216,000 gallons, and the reservoir holds 100,000 gallons. The capacity of discharge of the pipe is said to be 345,000 gallons daily.

The detailed cost of the work was as follows:

Materials—		
2,101 8 in. pipe	$13,356.88	
Special castings	174.84	
9,185 lbs of lead	856.32	
1,340 lbs. oakum	222.10	
Gates and air cocks	228.00	
Freight on pipes, gates, lead, etc	3,032.28	
Cartage of gates, etc	51.60	
Distributing pipes on line	689.45	
Total materials		$18,611.37
Less value of material left over		375.00
		$18,236.37
Laying—		
Trenching on back-filling, 28,400 ft.	$1,067.40	
Labor laying pipes	456.73	
Labor setting valves, etc	78.75	
Total labor		$1,602.88
Total cost of pipe laid		$19,839.25
Land damages on pipe line		52.00
" " at reservoir		237.00
Dam and Reservoir—		
Labor	$377.23	
71 bbls. cement	132.50	
Freight and hauling	137.71	
		$647.44
Service Pipe—		
800 ft. of 1 in. pipe along building, with stops, etc.		121.56
Engineering		938.00
Total cost		$21,835.25

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From B. R. Norman, Clerk to Water Board, statistics of Marion, Ind., water-works. From Lieut. R. L. Hoxie, U. S. A., Report of work on Washington Aqueduct, June 30, 1881. From J. L. Fisher, statistics of Tiffin, O., water-works. From J. C. Isaacs, Secretary, statistics of Walla Walla, Wash. Ter., W. W. From J. E. Bonebrake, President Water and Gas Co., statistics of Abilene, Kan., W. W. From A. F. Matlack, City Clerk, additional notes regarding Stubenville, O., W. W. From G. W. Howell, C. E., Report of Water Committee of Lebanon, Pa., November, 1882. From Nelson Bennett, Superintendent, statistics of Thomaston, Conn., W. W. From Leonard Treman, President, statistics and water rates of Ithaca, N. Y., W. W. From John Patrick, Superintendent, statistics of the Parkdale, Ont., W. W. From Daniel Ransom, statistics of the Longmont, Col., W. W. From Isaac S. Cassin, C. E., statistics of water-works of Newcastle, Del.

A WALL STREET MAGNATE.

Business in the Wall street commission offices is dull, yet there is at least one man who always makes money in the street; but then he is an exceptional being, and his resources are unfathomable. That man is the *Hon. Russell Sage*. His main income is from the sale of privileges. Never mind how dull the market may be or which way it goes, there are always people willing to buy puts and calls as a protection against big losses, and Uncle Russell is always ready to sell them, especially if the broker is a man of the world and treats him nicely. The other day one of them promised a customer to buy for him a ninety-days' put on 200 shares of Wabash preferred at 46. The stock was selling at 54, and the broker thought he was sure to get it. But Mr. Sage happened to be in one of his close-fisted moods and would not sell it above 45. The broker showed him two brand-new hundred dollar bills. But nothing seemed to work.

"I'll tell you, Mr. Sage, what I will do. I'll give you $200 in cash and send to your house a ten-gallon keg of Bass' ale for yourself and a basket of flowers for Madam. You would really oblige me by selling that put. I promised to get it for a good customer."

"Never mind the flowers," answered the old gentleman, somewhat less harshly than he had spoken before—"Never mind the flowers. I don't want no flowers. Send me something else. Send me a gallon of good Keystone whisky. You know where to send it—506 Fifth avenue. Give me that money and go and make out the put."

The broker's commission was only $10, while his bill for the keg of Bass and the demijohn of whisky was $15.85; but he was delighted at being enabled to accommodate his customer. When the bargain was afterward related at Delmonico's another broker retorted: "Why, there is nothing new in that. I have been keeping the old fellow in groceries for two or three years past. But there is one thing to be said about Sage. If you spend a dollar on him you are almost sure to make $10, and if you spend $10 you make $400. I think if anybody had the pluck to spend a few hundred and buy him a horse or something of that sort, he would make his fortune, provided the old man did not jump the game after he got the horse."

Mr. Sage is supposed to be worth $20,000,000, and his fortune has been accumulated solely by this kind of strict personal attention to the details of all business transactions. He is one of the thirty New Yorkers whose joint wealth is estimated at over one thousand millions of dollars, and would probably be still larger were they all like him.—*N. Y. Sun.*

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR............ASSOCIATE EDITOR.

SATURDAY, DECEMBER 16, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6 50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
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Sanitary Engineer	2.75	3.00
Railroad Gazette (new subs.)	3.50	4.20
" " (renewals)	3.90	4.20
American Architect	5.00	6.00
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Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do this we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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NOTICE OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 127 East Twenty-third street, New York. The thirtieth annual meeting of the society will be held in New York, on Wednesday, Jan. 17, 1883, at 10 A. M. The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, proposed amendments to the constitution discussed, and other business transacted. Arrangements for Jan. 17 and 18 will be perfected by a committee, and you are invited to be present at the meetings on those days.

"EXCAVATING WET MATERIAL BY HYDRAULIC PROCESS" is the subject of the paper read before the last meeting of the Western Society of Engineers by J. C. Dodge.

President CHARLES LATIMER of the International Institute for Preserving Weights and Measures, says that "The object of our association is to preserve the records of the past, in our hereditary weights and measures, and by digging into the monuments of the past to understand the origin of the weights and measures that we have. In this investigation we are led into the subject of races and nations, and it opens one of the widest fields of investigation and research. We claim that the great pyramid of Ghizeh holds within it the whole subject of the weights and measures of the Anglo-Saxon race, and our investigations are in that direction at present. We believe that it not only holds this, but also an epitome of all the sciences known to the race of man."

◆

BOGUS INVENTIONS.

Letters patent protect two classes of individuals occupying the extremes in the inventing world. First, those who study a subject with the intention of honestly improving it; second, those who study the movements of the first class and steal everything they can. All honor is due to the honest man who, by patient experimenting, close application, deep study and much expenditure, produces a device destined to make more subservient the forces of nature. This man makes himself familiar with what has been accomplished in the particular branch to which he is devoting his attention, and then seeks to push it another step toward perfection. We cannot throw our glance to any point in the civilized world without meeting overwhelming evidences of his unremitting labor.

The deepest contempt should be manifested toward the second class, which, we are sorry to say, is much too numerous. This class may be further divided into those who, becoming suddenly convinced that they have an all-important machine or even a single part of a machine, rush to the patent office for protection. In the majority of cases these devices have not been practically tested, nor even theoretically demonstrated, their merits and demerits are only guessed at and the mere supposition that they might be of use in some part of a work, has led the seeker after "royalty" to protect them. The second division steals the work of the honest inventor. The smallness and apparent insignificance of these things never effect the zeal of the pirate. His attentions are given to the big and the little; sometimes the latter is preferred.

From these simple facts has arisen the holy horror in which every honorable member of the profession holds these people, and the dread he has of showing the result of his work before he has filed his claims for fear his idea of a bolt of peculiar construction may be stolen. The thief knows that a machine which would do that particular work successfully would be valuable; he also knows that peculiar bolt is vital; consequently, if he can control the use of the bolt, he has, practically, the controlling use of the whole thing. The only redress is now in the courts, and as the choice between the thief and his royalty and the lawyer and his fee is about even, a compromise is effected, and the peculiar bolt has made the fortune, not of its creator, but of its owner.

The holders of patented devices, which have not been recognized as undoubtedly the best, pursue two courses to obtain the approval of their machines, either in works of great magnitude or where they are of such a high character as to make a reputation for any article used in their construction. One is in the case of work let by contract to have the device adopted by the promoters and made compulsory by the specifications. But failing in this the patentee goes to the successful bidder and tries to bargain with him for the use of his invention. We were informed of an instance this week where a contract had been let for a certain number of cars, the specifications being very carefully drawn. Two men holding patents and having failed to influence those in charge, posted off to the builders the instant the award was made public.

For these many reasons projectors and builders are very loth to publish detailed drawings, or even complete descriptions of their devices before the whole thing has been put in working order, and they are very careful to whom they even briefly describe their endeavors.

Give this class of inventors the merest inkling that you are trying to do certain things, which if successful will pay, and they will file claims on every possible method and every detail. They work on the principle that the device may possibly be a part of your own, and if so, and you can not devise something instead you are at their mercy. The idea of making practical tests and carefully experimenting, and working from a few disjointed ideas up to a completed whole, expending time and money with but one object in view, never enters their heads; and if an honest ambition, seeking a place of lodgement, should stray in, the uncongenial surroundings would quickly smother all its fire.

◆

A HYDROGEN GAS COMPANY.

The Equitable Gas Company has asked permission of the Gas Commission of this city to erect works and lay mains under the streets. They will agree to furnish gas of not less than 25 candle power at a rate not exceeding $2 per thousand to private consumers, and $16 per lamp for street lamps burning 3,833½ hours, consuming three feet per hour at a pressure of one inch. The company was incorporated March 9, 1882, with a capital of $2,000,000.

The President of the company stated that pure hydrogen gas would be used, and that the method of manufacturing it cheaply was invented by the late Tessie Da Motay.

The calorific properties of hydrogen are greater than those of any other substance; when carbureted it forms an illuminant of great brilliance, and the products of combustion are harmless. Owing to the many uses it could be put to, almost innumerable have been the efforts to produce it in large quantities and at a comparatively small cost. The most general plan, and one which has attracted attention for years, is the decomposition of water by bringing it in contact with a substance having a strong affinity for the oxygen, thereby liberating the hydrogen. Nearly all the cheap compounds in which hydrogen appears as an element have been experimented upon with only this object in view. So far the cost of obtaining the gas has been in excess of the value after obtained, and for this reason the devices have failed of adoption, although practicable.

The Equitable Company propose to obtain hydrogen by the decomposition of steam and liquid hydro-carbon in contact with highly heated lime. A nearly pure gas can be obtained in this way, and after having been carbureted gives an illuminating power of from 30 to 50 candles. In this process no loss is occasioned in the lime, as it is being continually revivified by heat. The success of the plans depends entirely upon the cost, and as it is the first attempt upon so large a scale to utilize hydrogen, every step will be watched with keen interest, should the city grant them the privilege.

Some years since it was proposed to obtain hydrogen by passing steam through coils of pipe containing small pieces of iron. An oxide of iron resulted and pure hydrogen obtained. But it was found that the oxygen bestowed its favors as liberally on the conducting pipes as it did on the refuse iron, and renewals were too frequently needed. Although the plan worked admirably, the running expenses were out of all proportion to the benefit derived, and the idea was abandoned only to be revived again and again in following years with few or no attempts at changes, and as a suitable substitute could not be found for the iron pipes, the old result occurred.

PERSONAL.

MR. WM. F. BLAKENEY, the inventor of the turbine water wheel, died at Dayton, O., on Saturday night the 9th.

DAVID H. COYLE has recently been elected Chief Engineer of the Water Department of Wilmington, Del.

AUSTIN LATHROP, an extensive railroad contractor, of Corning, N. Y., has been appointed Commissary General of Subsistence on Governor CLEVELAND's staff.

MR. GEORGE B. N. TOWER, Supervising Inspector of Steam Vessels for New York and New England, has been superseded. MR. TOWER is the author of a little book on American bridges.

ATTORNEY GEN. MARSTON, as representing the

Commonwealth of Massachusetts, was in Rhode Island last week before Commissioners appointed to determine the boundary line between Massachusetts and Rhode Island.

GEO. S. FIELD, President of the Central Bridge Company, of Buffalo, has been appointed Engineer-in-Chief of Governor-elect **CLEVELAND**'s staff. Mr. **FIELD** is an accomplished engineer and has a very large acquaintance in this city and State.

H. C. LOWRIE was re-elected to the office of City Engineer of Denver, Colo., for the sixth time on the 5th inst. Mr. **LOWRIE** was appointed Chief Engineer of the Denver & New Orleans Railroad on April 1, 1881, and he held that office and the office of City Engineer of Denver until Nov. 15 of that year, when the term of the city office expired, and he was not a candidate for re-election, Mr. E. H. **KELLOGG** being elected. During the past year Mr. **LOWRIE** has had charge of the construction of 140 miles of railroad, and the location in great part of nearly 400 miles of main line. He has resigned his position in the railway to accept the city office. Mr. **LOWRIE** devised the sewerage system of Denver, and under his charge the sewers were built.

HENRY T. BOVEY, M. A., Asso. Mem. Inst. C. E., Mem. A. S. C. E., Professor of Civil Engineering and applied Mechanics, McGill College, Montreal, will assume the editorial control of the *Canadian Magazine of Science and the Industrial Arts*, on January 1, ensuing. The journal has heretofore been known as the *Scientific Canadian*, and it is the official gazette of the Canadian Patent Office. The proprietors, the Burland Lithographic Co., 5 and 7 Bleury street, Montreal, intend to do all they can to add to the interest and value of the magazine. The first number will contain, among others, articles on Technical Education, by J. Clarke Murray, LL.D.; on Cable Traction for Tramways and Railways, by C. F. Findlay, M.A., Associate Mem. Inst. C. E.; and on the Transit of Venus, by Alexander Johnson, LL.D.

LONDON CORRESPONDENCE.

SPECIAL TO ENGINEERING NEWS.

LONDON, Dec. 2, 1882.

In opening my correspondence to-day I may be excused for dwelling shortly on the general conditions of trade prevailing at present in England. The prospect is less favorable than it was a few months ago, and the Board of Trade return for October disclosed a decided pause in the progress of our exports. The next return, which is expected on Dec. 8, is looked for with some anxiety, and I shall probably have to place before your readers an even more unfavorable statement. At any rate, with the prevailing depression in the iron trade on your side, exports hence will probably again have fallen off, while trouble is apprehended in the textile trades. On the whole, a fairly active business is progressing, and it is thought with moderate profits; but the prevailing financial weakness, which has partly its origin on the Paris Bourse, imparts an uneasiness to our markets which is intensified at every depressing feature which may occur. Thus the unfavorable report on the American iron and steel trade at once produced increased dullness here, and the hopes of a boom in the States which were entertained in many quarters were thus dispelled. Generally speaking, however, it is hardly to be supposed that the cycle of progress which set in after the long lasting depression has already run its course, and it may be fairly hoped that only a momentary check has been experienced.

In our building trades considerable activity is displayed. In the metropolis, as well as in the large prominent towns, numerous old buildings are being pulled down and new ones erected. The new Law courts which will be opened by the Queen on Monday next form a magnificent gothic structure. Many, however, grumble at the slate roofs which the architect has introduced, and which certainly are the reverse of picturesque. It is suggested that red tiles would have greatly relieved the otherwise very sombre structure. Speaking of roofs I may mention the manufacture of a new material known as "vitreous iron plates," and which it is asserted will supersede galvanized iron, is about to be commenced at Derby. The patents originated in the mode of applying vitrified or enamelled plates to the bottom of ships and other submerged substances After many trials the patents were secured for iron houses and the roofing of buildings, as also for the lining of water tanks, beer barrels, etc. The great dock at Poplar has been completed by the Midland Railway Company, thus bringing the mines of the North and the Midland into direct railway communication with the River Thames. The work has been on hand for four and a half years An Irish engineer, Mr. Charles King, has come forward with the startling scheme of connecting Great Britain and Ireland by land. In a pamphlet, accompanied by a chart, he explains his proposal to construct an isthmus of the average width of 100 yards between the headland of Cartage in Scotland, and Tersor Point in Ireland, a distance of 19 miles, while the depth of the sea is 474 ft. deep at mid current. The cost of the isthmus is estimated at about £2,000,000. The scheme otherwise is so exceedingly wild and useless that John King will not find anybody to take it up.

The metal markets are at present in a very dull condition. Even copper, which is said to be so largely used in the electric industry, has relapsed £66 2s. 6d.@£66 12s. 6d. for Chili Bars cash. Lead and Spelter are quiet. Of the dullness of the iron trade I have already made mention. The ring in pig iron between Scotch and North of England makers is broken up and prices have suffered, warrants of Scotch pig iron having receded in Glasgow to £48 5s., but the full effects will hardly be felt until we are well in the winter, when as a rule exports slacken and stocks increase. Stocks in Glasgow are moreover very heavy. They stood at the end of last year at about 940,000 tons, and up to now, notwithstanding the restrictive movement, this immense store has only been reduced by some 12,000 tons. Ship building is not quite so active as before, but sufficient orders for vessels are in hand to provide remunerative work for some time to come. Bridge builders, locomotive makers, wagon builders, engine and boiler makers, etc., are also full of work. On the other hand, manufacturers of rails complain, and are endeavoring to form an alliance to improve their position. That the continuance of orders going to England from the United States is very small appears now pretty certain unless prices on your side should rise considerably, which is not likely. Taking the cost of English steel rails, including present low freights to New York and insurance at, per ton, £6 5s. 6d. ($30.50), and the import duty in United States, £5 15s. 6d. ($28), we get at the figure of £12 1s. ($58.50), while the present price of American rails at works is $40. India and the colonies may for the present only replace American orders; but as a number of new mills in different parts of Great Britain are about to be started, the already existing productive power of about 1,500,000 tons will be increased by further 806,000 tons per annum.

The following is a report on the London market as far as of interest to your side:

STEEL AND IRON.—Steel rails, f. o. b. usual ports. The market does not present any new feature, price remaining nominally as below, £5@£5 5s. per ton f. o. b. Cumberland ports; £5 7s. 6d.@£5 17s. 6d. f. o. b. Wales and Middlesboro'; according to weight, sections and specification. Old rails do not command any attention, except for consumption at home, the nominal prices, f. o. b. home ports, are O. D. heads. 72s. 6d.@75s. per ton; flanges, 65s.@67s. 6d. per ton; bridge about 70s. per ton. Iron rails, f. o. b. usual ports, nothing doing. Heavy wrought scrap-iron, 60s.@62s. 6d. per ton net cash, f. o. b. London and out-ports. Old railway leaf spring steel, c. i. f. usual ports, £5@£5 2s. 6d. per ton, but nothing doing. Steel blooms, 7 in. by 7 in. and upward, f. o. b. usual ports, £4 12s. 6d.@£4 17s. 6d. per ton, but no inquiry. Bessemer pig-iron, Nos. 1, 2 and 3, f. o. b. usual ports, very flat at 55s. per ton and over according to brand. Bar iron, f. o. b. Wales, common qualities and assortments, £5 10s.@£5 15s. per ton. Crop ends dull at 60s.@62s. 6d. per ton f. o. b. Wales.

It is stated that M Lazare Weiller, of Angoulene, has at length found a suitable material for telegraphic purposes analogous to phosphorbronze, which is used for telephone wires, but has not sufficient conductivity for telegraphic purposes. The new material is silicious bronze, in which the deoxidant consists of a silicious metalloid that produces a better conductor than the phosphorus. The results of experiments are said to have been very satisfactory.

Italy has been spending public money very freely of late in the construction of public works, the budget now standing at £12,200,000, as against £6,000,000 in former years. Already the length of railways in operation has increased from 5,100 miles in 1878 to 5,700 miles, and since 1778, 347 locomotives, 850 carriages and 5,714 wagons have been bought.

Messrs. Craven Brothers, of Manchester, are at present engaged on two orders for the complete equipment of locomotive tools capable in each case of turning out 50 locomotives per annum—one for the Canadian & Pacific Railway Company and the other for the Franco-Belgium Works. They have also orders on hand for 28 large traveling cranes, ranging up to 30 tons.

THE FORTH BRIDGE.—Preparations are now being made with activity, in order to enable the contractors for the construction of the Forth Bridge to begin work as soon as the condition of the weather will allow them to do so. The works for brick-making, tradesmen's shops, stores and plant prepared for the former contract held by Messrs. Arrol & Co., Glasgow, are being rendered available again; so that in this way there will be a considerable saving of time. Sir Thomas Tancred, of London, one of the contractors, has taken a lease of premises in South Queensberry for five years, the time within which it is expected that the great undertaking will be completed.

The present statistical position of pig iron is shown by the following figures:

Furnaces in blast in Scotland, 114, against 105 on Dec. 2, 1881.

	Dec 1. Tons.	Nov. 24. Tons.	Dec. 1, 1881, Tons.
Stock of pig-iron in Connell & Co.'s stores at Glasgow	612,867	615,936	620,906
Decrease for the week	3,068		
Stock of pig-iron in Connell & Co.'s stores at Middlesbrough	100,861	100,961	170,066

Shipments of total of Scotch pig-iron from Dec. 25 until Nov. 25—

	Tons.		Tons.	Total tons.
1882—Foreign	408,875	Coastwise	174,230	582,105
1881—Foreign	347,267	Coastwise	181,333	528,600
Total increase in 1881				545,061

According to the *Bulletin des Adjudications* (Paris, November 28), the Austro-Hungarian Government has made an arrangement with several French bankers (who are proprietors of Hungarian patents for mining and crushing machinery), under which the latter are to develop the gold mines of the country. The necessary staff and plant are to be provided by the Government, and the syndicate is to hand over to it the same quantity of ore as was being raised at the time of their commencing work, any surplus output being divided in certain proportions between the two parties. It is believed that this system of working will greatly tend to the full development of the Government mines.

THE SOCIETY OF ENGINEERS.—The Council of the Society of Engineers have made arrangements for three courses of lectures to be delivered in the hall of the Society during the present winter season. The first of the series, "On Strains in Ironwork," will be by Mr. Henry Adams, professor of engineering at the City of London College, and will comprise eight lectures, the first to be given on Thursday, Dec. 7, and the others on succeeding Thursdays to Feb. 1, 1883. The second course, "On Land Surveying and Leveling," will be delivered by Mr. A. T. Walmisley, and will also consist of eight lectures, beginning on Monday, Jan. 8, 1883, and continuing on successive Mondays until March 12. The third series, "On Water Supply and

Drainage," by Mr. R. W. Peregrine Birch, will begin on Thursday, Feb. 8, 1883, and be continued every Thursday until April 5. The special object of these lectures is to assist in the technical education of young engineers.

The *Gaceta de la Industria* (Barcelona, November 18), publishes the following statistics of the Spanish railways at the end of 1880: 4,656 miles were at work, for the construction of which subsidies amounting to 356,672,199 pesetas had been granted by the State. The shareholders' capital amonted to 533,691,416 pesetas, while the debentures issued by the companies showed a total of 1,085,369,507 pesetas. The number of passengers carried was 14,833,321, producing 46,374,097 pesetas. During the year 11,305,495 tons of goods were carried. These produced 94,541,374 pesetas. The rolling stock consisted of 1,245 locomotives of the united horse power of 439,053; 1,553 tenders, 3,669 carriages, and 21,949 goods wagons. B.

HODS.

Hods are of two kinds. One form of hod is devised for carrying bricks, and the other for the transportation of mortar. While differing somewhat in purpose and balance, the two species of hod are yet so closely allied as to be utterly indistinguishable when apart. Indeed, it is a matter of grave interest to men that during the whirl of centuries, when every other inanimate thing has, through the indomitable perseverance of invention been forced through a process of evolution that has robbed it of almost every semblance of its pristine nature, the hod remains to-day in structure, substance and design exactly as the hod originally was. At present hods are cheap. Eighty-four cents will purchase one. The craze for all that is æsthetic, early English, Japanese' Etruscan or antique has passed by the hod unchallenged. The early Irish hod still reigns supreme.

The dimensions of a mortar hod are as follows: Length of bowl, 22⅜ in.; mean depth of bowl, 9½ in.; greatest width of bowl, 9¼ in.; height of back piece, 12⅜ in.; width of piece forming lateral sections of bowl, 11½ in. The dimensions of a brick hod, it will be seen, are different. They are as follows: Length of bowl, 23⅜ in.; mean depth of bowl, 8 in.; greatest width of bowl, 8½ in.; height of back piece, 10¼ in.; width of pieces forming lateral sections of bowl, 8⅜ in. It is generally conceded that the mortar hod is built larger than the brick hod so as to make the weight when both are loaded as nearly equal as possible. The shank or handle is 4 ft. 2¼ in. for each species of hod, and the shoulder rest is always 9 in. long, 3 in. wide, and 1¼ in. thick. This shoulder rest is attached to the inverted ridge-pole of the hod, and prevents the edge from cutting into the shoulder of the proprietor.

Touching the materials used in hod building, it may be said that the earliest ideas still obtain. Iron hods have been tried, but abandoned, because they were liable to rust and to become cracked when dropped six or seven stories by proprietors, who invariably, and instantly, relinquish all ideas and implements of labor at the stroke of 12 and and of 6. The verdict of ages is that the bowl of the hod shall be of yellow pine, and the shank a hickory pole with the bark on. In constructing a hod, it is found necessary to use thirty-three nails for the brick species, and twenty-nine nails and four screws for the kind intended for mortar. The screws are used in the latter instance to fasten the two arms of the shank to the bowl, because screws do not leave holes, as do nails, when they become loosened. Small holes allow mortar to escape, and are therefore open to objections. In making the bowl of a hod, eightpenny nails are used; fourpenny nails answer best for the shoulder rest, and shingle nails for securing a narrow strip of sheet iron that runs over the top of the back piece of the bowl for the purpose of impart additional strength. All of the nails are machine-made, with the exception of those used in fastening the shank to the bowl, which are hand-made and highly malleable. The mortar hod, besides having four screws, is lined at the seams with white lead. It has been considered somewhat superior to the brick hod. The weight of hods one hour after completion is ascertained to be exactly as follows: Brick hod, 9 lbs. 6 oz.; mortar hod, 10 lbs. 3 oz. Fifteen bricks are carried in the common hod.

There is a widespread impression that the shank of a hod is steamed after being split into the V shape necessary to accommodate the bowl. This is erroneous. The shank, after being split for a distance of 7⅝ in., is violently forced asunder by pressure against the wedge-like base of the bowl, and is secured while in that position.

Very many hods are owned privately, and many thousands more are owned by a large company up town, which makes hods and rents them to builders along with its patent hod elevators. The introduction of hod elevators, oddly enough, met with no opposition from individual proprietors of hods; but, on the contrary, was warmly welcomed by them. The elevators do the work of many men, but as building has increased in a satisfactory ratio, there has always been enough work for men who decided to adopt the hod as a means of advancement or sustenance. Indeed, so well have the individual hod proprietors in question adopted themselves to the existing state of things, that they absolutely refuse to climb higher than the second story now, and builders must, perforce, employ the elevators for stories of a loftier pitch.

At no time in the annals of the city has the hod industry been at a higher tide of prosperity. Thus the outlook for the hod is as bright as its history has been unvarying.—*N. Y. Sun.*

THE KEELY MOTOR.

AN EXPERT REPORTS THAT KEELY HAS DISCOVERED ALL THAT HE HAS CLAIMED.

PHILADELPHIA, Dec. 13.—The annual meeting of the stockholders of the Keely Motor Company was held this afternoon, at which the report of William Boekel, who was chosen by the stockholders and Mr. Keely as the custodian of his secret, supplemented by another report from Mr. Keely himself, was presented. Mr. Keely's communication says that his engine will soon be completed and in full operation, and that it is his purpose soon to bring the matter to the attention of the Pennsylvania Railroad Company with a view of having the engine first applied on their road between Philadelphia and New York. Mr. Keely assures the stockholders that he has passed the line of experiment and nothing is left to be done but the completion of the mechanical work now being done on his engine. He says in conclusion: "At your request and with the aid of Mr. Boekel and of counsel I have prepared a caveat for my generator, which has been forwarded to the Patent Office."

Mr. Boekel, in his report, after sketching the corporate existence of the company, treats of the great possibilities of natural forces, which, he says, Mr. Keely has been assiduously studying until the inventor's "investigations and experiments have carried him far beyond the laboratory experiments of such men as Prof. Tyndall and other scientific investigators, and he has succeeded in exciting, harnessing and utilizing the subtle force which to them has been only a subject of scientific wonder." Then he goes on to show that what Mr. Keely claims to have discovered is "the fact that water in its natural state is capable of being, by vibratory action, disintegrated, so that its molecular structure is broken up, and there is evolved therefrom a permanent expansive gas or ether, which result is produced by mechanical action. Very many of those to whom this communication is addressed have frequently seen at the workshop of Mr. Keely the evolution of this substance and its registry in a chamber, where it exerts an expansive energy of upward of 25,000 pounds to the square inch." The report does not describe the mechanism employed, as Mr. Boekel says that would be improper, but he concludes that Mr. Keely has discovered all that he has claimed, and that the stockholders should abide in patience the success of the enterprise. With respect to the great lapse of time since the announcement of the discovery and the practical utilization thereof, the report says that Mr. Keely has constructed three engines at different times, each being an improvement on its predecessor, but none of them equal to a fair test, but now he is engaged in the construction of a vibratory engine of 500 horse-power.

Mr. F. G. Green of New York, the treasurer of the company, submitted a statement of the financial condition. The disbursements of the revenue obtained by the sale of stock since December, 1879, are: 7,532 shares, $46,391.75; 1,500 shares paid to J. W. Keely on account of engine, 2,748 shares for loan of stock previous to consolidation, and the balance of the stock, 8,300 shares of the entire 20,080, is in the company's possession. The cash balance is $58.84.

At a special meeting of the stockholders, which was held prior to the general meeting, the question of reducing the number of directors from thirteen to seven was discussed and agreed to.

This afternoon the following directors were elected for the ensuing year: E. J. Randall, W. W. Wright, E. B. Haines, F. G. Green, R. Baldwin, George B. Collier, and J. J. Smith.

* * *

HOW TO BE WEATHER-WISE: A new View of Our Weather System. With Illustrations. By Isaac P. Noyes. 12mo., pp. 51; price, 25 cents. Fowler & Wells, Publishers, 753 Broadway, New York.

This is a brief and plainly-written explanation of the causes of changes in the weather, based upon the system of the United States Signal Service. It also explains the nature of that service. Comparatively few appreciate the value of the Weather Bureau, because its work is but little understood by the people who read the daily "Indications." Mr. Noyes shows how the data are obtained for these indications, and how simple a matter it is to observe weather signs, when the principle involved in weather movements is understood. Everybody, he claims, can observe the weather himself and be his own weather prophet, and, in good, square English, he indicates the way. Let those who would know how to be weather-wise send 25 cents in stamps to the above address and secure this interesting work.

THE ST. GOTHARD RAILWAY.

The opening of the St. Gothard Railway through the Alps has moved Consul Byers, of Zurich, to write a sketch of the great tunnel. The pass of that name is over the highest mountain chain in Europe. The old post-road, commenced in 1820, 7,000 ft. above the sea in places, was 18½ ft. wide. It crossed gorges, clung dizzily to steep mountain sides, and was roofed over where most threatened by avalanches. When the first railway was opened, in 1846, from Baden to Zurich, it was proposed to ask concessions to enable the company to attack one of the high passes, and in 1863, a union, or society, for the purpose was effected, upon the basis of an estimated cost of $37,400,000. In December, 1871, the St. Gothard Railway Company was organized, $6,800,000 stock and $13,600,000 of bonds was issued, a contract was made calling for completion in eight years, with a forfeit of $1,000 for each additional day and a bonus of $1,000 for each day gained upon the contract time. Work began in the summer of 1872, and it was soon discovered that the estimates were wrong, and that $57,800,000 would be needed to carry out the plan; a crisis followed, and the enterprise seems to have been saved only by what had already been invested in it, leaving no way out but to push ahead. The railway proper extends 113 miles from Immensee, in Switzerland, to Chiasso, in Italy, and more than one-fifth of the whole line is in tunnels—fifty-six in number; many of these are not straight, but actually spiral, accomplishing heavy ascents in short distances, and there are also many lofty viaducts, bridges and complicated galleries. The total length of tunneling is 23 miles. The main or great tunnel is 9¼ miles long, although others, exceeding 6,000 ft., might be thought noticeable elsewhere. The great tunnel is 26 ft. wide and 19 ft. high. The modern boring machines were worked by air compressed by large turbine wheels driven by the rapid River Reuss. The air was carried from the compressors outside to the bores within the tunnel in iron pipes of six inches diameter, and the escaping air served an indispensible purpose in ventilation; 3,500,000 ft. of compressed air were daily thus delivered and set free, pushing back and out of the tunnel the bad natural gases, with those set free by the dynamite and thrown off from animals and workmen. Fifty drills were worked; the usual daily advance was 21 ft., working from both ends, and the whole excavation was lined as fast as made with a circular tube of masonry 18 to 30 in. thick. The workmen were principally Italians, who worked eight hours a day, receiving 60 cents to $1.20 per day (mostly the former), boarding themselves, and living chiefly on meal porridge; yet most of them are reported to have saved and sent home to their families a part of this pittance. The tunnel cost 310 of their lives, and wounds were inflicted upon 877. The final actual cost of the tunnel and railway, exclusive of rolling stock, is now reported at something over $40,000,000.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

NORTH ATTLEBORO, MASS., WATER-WORKS.—Percy M. Blake, Civil and Hydraulic Engineer, of Hyde Park, Mass., on the evening of the 8th, presented to a meeting of the business men of North Attleboro and Plainville, plans and estimates for a water supply of those towns. It is proposed to take water from Bacon's pond, in Plainville, the pumping engine to be located there; the reservoir, with a capacity of a half million gallons, is located on Watery Hill, 160 ft. above street level. The piping is estimated at 9.7 miles; total estimate expense, based on iron piping, is $111,341; for cement-lined pipe, $20,000 less. This includes everything pertaining to the water-works, in complete condition. In addition to the reservoir, Mr. Blake's estimate included an iron stand-pipe 50 ft. higher than the reservoir, for the purpose of furnishing a supply to those who have residences on the highest ground in the village. Hydrants are located on an average of 650 ft. the entire distance, and the supply, he guarantees, is sufficient for eight fire streams to be used at once if necessary. Letters were read from prominent responsible contractors who had offered to take the various contracts at figures less than the estimate made by Mr. Blake. The report was very gratifying and the estimate much below the ideas of many who have given the matter consideration. Steps will be immediately taken to draft a bill to present to the next Legislature, and an opportunity given to citizens to form a water-supply district or make it a private enterprise. Either way it now looks as if the village, which is one of the most prosperous and goahead in the State, would have an excellent system of water supply before another winter.

Boston will not extend its high service water supply at present.

The new engine of the Phœnixville, Pa., water-works is being put in place.

The semi-annual cleaning of the 16 miles of conduit of the Boston Water-Works, between South Framingham and Chestnut Hill Reservoir, was begun Tuesday morning. About 40 men will be employed, and three days' time will be consumed.

Billings, Mont., has had a meeting of citizens to discuss the subject of fire protection, and a committee has been appointed to see about the digging of wells and the purchase of a fire engine and the necessary hose. Mr. Geo. D. Rice, C. E., formerly of Boston, Mass., is one of the committee.

ELECTRICITY.

The Maxim Electric Light is being introduced into the larger factories at Allentown, Pa.

STREETS, DRAINAGE, ETC.

F Theodore Walton, who now has the contract for cleaning streets of this city, has offered to clean the streets of Philadelphia for five years for $500,000 a year.

Washington, D. C., will repave many of its old streets and open new ones during the coming year. The estimated cost is as follows:

Replacing wood pavements	$240,392.25
Replacing stone pavements	34,487.50
Laying new pavements	59,406.50
Grading and regulating	40,437.00
Total	$374,723.25

The wood pavement of the Champs Elysees, in Paris, is being carried on at a rapid rate, and the portion between the Place de la Concorde and the Avenue de Marigny has just been completed. There cannot be two opinions as to the desirability of this improvement, as the sorry condition of the old carriage road formed a chronic topic of legitimate complaint.

RAILROADS.

The Atlantic-Pacific Tunnel and Gray's Peak Railway Co. is the name of a new corporation formed for the purpose of building a railroad to the summit of Gray's Peak in Colorado, an elevation of 14,341 ft. above sea-level. The capital is $2,000,000, and the officers of the company for the first year are M. M. Pomeroy, President; L. C. McKenney, Vice-President; A. D. Whitaker, Secretary, and Douglas Washburn, Treasurer, with offices in Denver.

The Reading Railroad is to be connected with the New York Central system by the construction of a road from Salamanca, the eastern terminus of the Erie Railway, to Williamsport, the western terminus of the Reading, and a traffic combination between Vanderbilt, Gowen and McHenry has been formed to divert trade over the new line between Buffalo and Philadelphia, leaving New York "out in the cold." To counteract these schemes, the Pennsylvania Central will build a parallel road to Reading.

By the completion on the 11th of the new Milwaukee & Lake Winnepeg R. R., the Wisconsin Central R. R. gains an independent outlet from Milwaukee.

The New York, West Shore & Buffalo Railroad Company has contracted with Troy firms to furnish it 20,000 tons of steel rails, 67 pounds to the yard, at a few cents over $40 a ton, the rails to be delivered as wanted along the line of the road. Contracts for delivery of a large quantity of rails at Buffalo at the same rate will probably be effected this week.

It is stated that the connecting link between the West Maryland and B. & O. railroads will certainly be built. Committees to solicit subscriptions are now at work.

New Road Building.—The Grand Trunk is building a new air line to Detroit via Jackson, which will be twelve miles shorter than the Michigan Central.

The Mexican National.—On the 12th a section of 14 kilometers of completed road between Monterey and Santa Catarina, on the Coahuila Division of the Mexican National Railway, was examined by the official inspector and accepted on behalf of the Mexican government. Under the terms of the concession granting $7,000 per kilometer of accepted road the company will receive immediately $98,000. Track is already laid for sixteen kilometers south of Santa Caterina. The company has now 284 kilometers open for traffic in Northern Mexico, making a total on the Northern Division, from the port of Corpus Christi, Texas, to Santa Catarina, of 500 kilometers of completed road.

Correction.—In the edition of Dec. 9, under the head of "A Pennsylvania Road," you have the name of the road wrong. Instead of *Conewago* it should be *Colebrook*. Part of the road follows the Conewago Creek, but the chartered name is the Colebrook Valley Railroad Company. I am connected with the road, and can therefore speak understandingly.

Respectfully, J. B. Rohrer.

The Central Railroad of New Jersey will extend their line through upper Lehigh into Freeland.

A dispatch from San Diego, Cal., announces that ground has been broken for the Baja, California & Sonora Railroad. The contract for the first 20 miles has been let. The road will run through Lower California, crossing the Colorado river near its mouth, thence through Sonora to Calabazas, in Arizona.

A corps of engineers is surveying the proposed new line of railroad from Tamaqua to Williamsport, Pa.

It is reported that the government is about to send an engineering commission under the direction of Dr. Carlos Alberto Morsing, to survey anew the route of the projected Madeira and Mamoré railway. The work, if it must be done, could not be entrusted to better hands.—*Rio News, Nov. 15.*

Completed.—The Turkey River branch of the Chicago, Milwaukee & St. Paul Railroad was completed from Dubuque into West Union last Saturday.

Articles of incorporation of the Fort Smith & Southern Railway were filed in Little Rock, Ark. The road will be fifty miles in length, and the capital stock $250,000, most of which is already subscribed. Waldron, Scott County, will be the southern terminus for some time.

BUILDING.

Union Depot.—Mr. Minot, the engineer of the Boston & Providence Railroad, is perfecting plans for a union depot at Providence, to be occupied by the Boston & Providence, Providence & Worcester, Stonington, and New York & New England railroad companies.

The architect of the new capitol at Albany was called to Columbia, South Carolina, to inspect the state-house and estimate the cost of completing it. He reported the building very unsafe, and showed that it is slowly parting in the center.

CONTRACTING.

The steel rail mills of the North Chicago Rolling Mill Co., at South Chicago, were shut down on the 11th. The mills at North Chicago closed some time ago.

The Delaware Rolling Mill, at Phillipsburg, N. J., was fired up on the morning of the 11th, after a month's idleness, but on account of a strike of the hands was closed down again during the day.

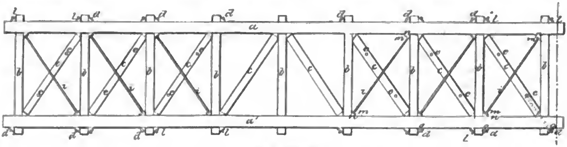
Bowers, Dure & Co., of Wilmington, are awarded the contract for 12 each, of long and short cars, for use on the Brooklyn Bridge, at $8,465 and $2,865 each, respectively. The contract for the boiler-houses and chimney for the Brooklyn side is awarded to W. H. Hazzard, Son & Co., at $18,818.

TRUSS BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

August 12, 1846, Horace Childs, of New Hampshire, received a patent for a truss-bridge. Childs employed suspension and cambering rods in such manner as to answer, in addition to these, the purposes of diagonal counter-braces, by using additional nuts above the lower and below the upper string, and passing diagonally through the stringers, bind and hold the posts in position. Combined with the diagonal thrust braces are short screw bolts, which pass diagonally through the stringers where they are united with the post at top and bottom to bind them together in the same manner, but in the reverse direction of the suspension rods.



Child's Bridge.

a represents the upper, and *a'* the lower chords; *b*, the posts, etc., the diagonal thrust braces made double and having a screw bolt, *d*, between them at the upper and lower ends. A pin, *e*, secures the bolts by passing through the brace and an eye in the end of the bolts. The suspension rods, *i r*, have, in addition to the outside nuts *l l*, two nuts *m m*, that bear against block *n n*, below the upper and above the lower strings, so that by binding the chords and posts at top and bottom by means of these nuts, the rods answer the double purpose of suspension rods and counter-braces, and the same time binding the posts and chords.

August 12, 1846, Frederick Harbach, of Massachusetts, devised a bridge truss. The figures show a side elevation of a part of the truss and a vertical section of the same. The inventor makes use of hollow metallic cylindrical beams for the chords, braces and counter-braces. *A B* is the top chord, composed of two parallel cast-iron tubular beams, made in sections and connected by lapped joints, seen at *K*. *C D* is the lower chord similarly constructed of tubular beams made of boiler iron riveted together *E* are the principal diagonal braces, and *F* the counter diagonal braces, all made of cylindrical tubes of wrought or cast-iron, and each cast with a toe piece, *a'*, at each end projecting from the opposite sides. *G* are the vertical suspension rods or bolts which pass down through the chords, toe pieces and counter-braces. The suspension rods are placed three abreast, with four nuts, *b' c' d' e'*, upon each, as seen in the sectional view. These rods connect the chords, and at the same time confine the braces and counter-braces in their

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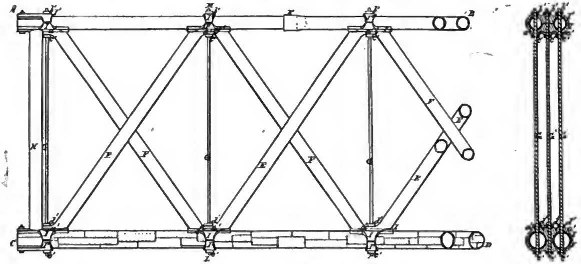
proper positions. At each end of the truss a cylindrical tubular post, *H*, may be inserted between the top and bottom chords, in order to aid in keeping them at their proper distance apart. *I* are metal saddles shaped to receive and support the chords. Counter saddles or stirrups, *I'*, are also employed. The ends of the braces and counter-braces rest in contact with the saddles *I* and are secured thereon by projections *f* raised upon the saddles, the toes of the braces abutting against them.

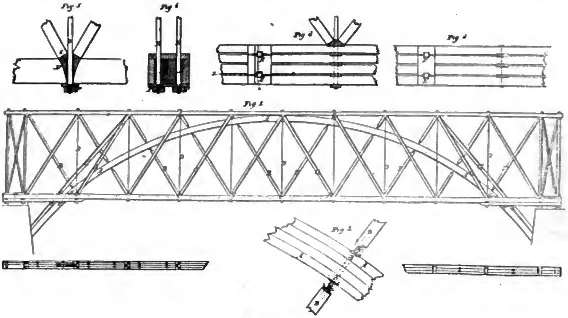
The stirrups and saddles prevent the chords from being crushed or flattened by the action of the bolts and nuts. By confining the toe pieces of each diagonal brace and counter-brace directly to the saddles *I*, Harbach converts the brace into a suspension and counter-brace, as well as a thrust and counter-brace, thus resisting the vertical strains upwards as well as downwards. This guards, in a great measure, against the undulatory motion so destructive to railroad bridges, when a heavy train of cars run over it.


HARBACH'S BRIDGE.

Aug. 28, 1846, William Howe, of Massachusetts, devised an improved truss bridge in which the arch beam is combined with the general truss in such manner that it may be made to co-operate with the other parts of the truss frame in raising or lowering the camber of the bridge. To accomplish this the inventor adopts a novel method of shortening and lengthening the braces.

Fig. 1 is a side elevation and Fig. 2 an enlarged view of the manner of connecting the arch beam with the counter-braces. Figs. 3, 4, 5 and 6 are detail views. The arch beam *A* passes independently between the principal braces *G*, which are double. The counter braces *B* abut on the blocks *c*, and are in the same plane with the arch, and when they would meet it they are cut off. The braces *B* have regulating screws *a a* tapped into a nut *C*. To render these metallic bearings independent of the shrinkage of the timber, there may be bolts *d*, shown by dotted lines extending from thence through the woodwork of the arch. *D* are the iron rods for straining up; they pass through the chords and have metal bearings in the sockets unaffected by the shrinkage of the chords. *E* represents said sockets extending entirely through the chords.

The arch is divided at the lower chord, as seen at *e e* so as to preserve the strength of the chord. Screws *f* are sometimes attached to the principal braces, the heads of which bear against the blocks *C*, which have a concavity in them for that purpose.



HOWE'S BRIDGE.

(TO BE CONTINUED.)

LONDON CORRESPONDENCE.

(Special to Engineering News, London, Dec. 9, 1882.)

The events of the week, besides the opening of the Law Courts on Monday, are the fearful conflagration, of which the cable will already have given you particulars. The burning of the Alhambra Theatre adds another to the warnings which have lately been given in the shape of theatres being burned down after the audience had left. If the Alhambra had caught fire earlier, a catastrophe as appalling as that of the Ring Theatre at Vienna might have ensued, the progress of the fire having been most rapid. The theatre is to be rebuilt at once, and there are indications that considerable alterations in the arrangements for exit will be insisted upon in all metropolitan theatres. The fire in Wood street, City, by which £2,000,000 value of property was destroyed, adds another to the large fires, the rapid extension of which made it impossible to save any buildings belonging to a whole block of houses. The risks appear to have been divided among the insurance companies. The want of easy means of access, on account of the narrow streets, appears to be partly the cause of the great extent of the catastrophe, while the inflammable nature of the goods contributed to rendering the destruction complete.

The number of large returns for new railways and other works to be submitted to Parliament next week is not so large as that brought forward a twelve month ago. The number of railway bills is 122 against 135 last year, that of tramway bills 31 against 26 last year. To that must, however, be added the large number of applications under the electric lighting act, which reaches 141. A number of extensions of railway communication in the metropolis are proposed, while all the chief railway companies have lodged bills for the construction of short connecting railway lines at different parts of their system. Tramways appear to be the order of the day, more especially round London. One of the most important of the undertakings for which authority is asked, is the Manchester Chip Canal, for which Manchester appears to grow quite enthusiastic. There appears to be every likelihood that it will be carried through.

There will thus be ample employment for engineers, contractors, and the allied trades, if even part of the schemes are sanctioned. It is needless to add that the introduction of the electric light alone which will now become general, will test the manufacturing and engineering power of the country to the utmost.

The Board of Trade returns for the month of November just published, show that the expansion of trade has decidedly received a check, and that the slightly retrograde movement shown by the October returns has made further progress. The total imports of merchandise into the United Kingdom in November amount to £34,901,910 against £34,269,784 in November 1881, and £38,429,362 in 1880, while the exports of British and Irish produce, £20,292,948 against £20,713,164 in November 1881, and £18,864,700 in 1880 show a falling off of about 2 per cent. This result has been more or less expected, as complaints were ripe for some time with regard to general business in the country. There can be no doubt that trade during the autumn has been very disappointing considering the more abundant crops both here and on the Continent, and with the figures of the Board of Trade return before us we can hardly hope for an early revival.

Imports of wheat from your side have kept up fairly well during the month and are, in fact, slightly larger than last November. There is, however, a large decrease for the month from Atlantic ports, the quantity reaching only 18,542,497 cwt., against 23,523,462 cwt. in 1881. Large quantities of cotton have been received from your side on account of the lateness of the crop, while reduced quantities of petroleum have been received in November. On turning to the exports it is rather surprising to find that, notwithstanding the dullness of our markets, the total exported of iron and steel from the United Kingdom reached the very high figure of 334,015 tons for last month, as against 309,436 tons in November, 1881, and 269,464 tons in 1880, bringing up the total for the 11 months to 4,062,215 tons, against 3,518,511 tons in 1881, and 3,558,824 tons in 1880. The following are the figures for the export movement to the United States in November, compared with the corresponding month of 1881 and 1880:

	1882.		1881.		1880.	
Pig iron	35,274	tons.	26,002	tons.	14,700	tons.
Bar Angle	2,290	"	4,106	"	1,691	"
Bolten iron	4,062	"	15,421	"	15,603	"
Railroad, etc., Hoop & sheets	.....		.....		......	
Boiler plates	4,136	"	2,640	"	3,071	"
Tin plates&sheets	16,711	"	14,320	"	13,586	"
Cast&wrou't iron	1,117	"	572	"	2,554	"
Old iron	6,875	"	8,156	"	1,037	"
Steel, unwrought	3,973	"	12,311	"	2,197	"
	75,067	tons.	83,660	tons.	54,462	tons.

It will be seen that exports of pig iron to your side have increased, but that under all the other heads excepting tin plates there is a considerable decrease, a very natural result considering the present state of the American free trade and the heavy fall in prices. The export of steam engines to the United States in November reached £4,212 value, as against £178 in 1881 and £15,247 in 1880; that of machinery £44,109, against £53,881 in 1881 and £32,380 in 1880.

Considerable excitement has been caused on this side by the publication of the reductions recommended by the American Tariff Commission, more particularly the changes proposed in the duty on Bessemer rails and iron. The question has, of course, a very important bearing on our markets, and will be followed with great interest. The adoption of a progressive commercial policy by the United States would in fact revolutionize the conditions of trade of the world, for the mercantile business in the British iron trade has been very quiet this week. Pig-iron is flat, and although prices for Scotch warrants rose to 49s. for wider centers, they receded at the close to 48s. 10d. The Cleveland iron market is also dull and the favorable return of the Cleveland iron masters had no effect on the trade. Stocks have decreased by 1,618 tons of pig-iron, whereas they were expected to show an increase considering the low shipments of late. The total stock of Cleveland iron is now 237,446 tons; the furnaces in blast are 121 in number, of which 85 are working native iron and 38 hematite. No. 3 prompt was dull at 42s. 9d.@43s. by merchants, while makers ask 43s. 6d.@44s. For the finished iron trade orders are scarce and prices weaker. Bessemer iron is easy in Barrow-in-Furnace at 56s. for mixed parcels, No. 3 forge at 54s. In Lancashire locomotive and tool-makers are busy, but in the general engineering branches a rather discouraging view with regard to the future is entertained. A heavy failure in Liverpool—that of Messrs. Biddulph, Wood & Stevens, with heavy liabilities, is another sign of the depression in the iron trade. The cause is put down to heavy losses caused by the numerous failures during the past ten years among the South Wales tin plate manufacturers. At Newport the Ebbew Vale Company have secured an order from the London & Southwestern Railway Company for 20,000 tons of 82-lb. double-headed rails. The following is a report on the London market in connection with your side:

Steel Rails, f. o. b. usual ports: prices continue nominally as quoted in our last, but the disposition is to accept any orders offering for delivery a few months ahead at rather lower prices. Old Rails are in rather more demand; we quote c. i. f, price of O. D. Hds. to-day at 82s. to 83s. per ton, New York. Iron Rails, f. o. b., usual ports: £5 2s. 6d to £5 5s. per ton f. o. b. Wales; on inquiry we found the makers indisposed to book an order under these figures. Heavy Wrought Scrap Iron, 60s. to 62s. 6d. per ton f. o. b. London and out ports. Old Railway Leaf Spring Steel, c. i. f. usual ports: £5 per ton offered c. i. f. Philadelphia for December shipment. Steel Blooms 7 in. by 7 in. and upwards, f. o. b. usual ports, nothing doing. Bessemer Pig Iron, Nos. 1, 2 and 3, f. o. b. usual ports, flat at 52s. 6d. to 55s. per ton. Bar Iron, f. o. b. Wales, etc., quiet at £5 10s. to £5 15s. per ton. Crop Ends, dull at 60s. f. o. b. Wales, etc.

The continental iron markets show little change, but are, if anything, weaker. Pig iron is drooping in Belgium. The same has to be reported of the Paris market. The figures just published of the imports of iron and steel during the first ten months of the year into France show about equal imports as corresponding to 1881 for pig iron, but a large increase of imports in manufactured iron and steel. The total production of pig-iron in Germany during the first ten months of the year was 2,424,552 tons against 2,237,980 tons in 1881.

Tin has suffered a severe relapse, prices of fine Straits closing at £95 to £95 10s. for cash, £96 to £96 10s. three months, English ingots, £100 to £101, or a reduction of £2 per ton for the week. This decline does not appear justified by the position as far as statistics go. The visible supply both for Europe and the United States amounts to 15,413 tons against 15,795 tons a month ago, 14,825 tons on 1st December, 1881 (price £105), and 19,986 tons 1880 (price £93). This position shows no discouraging movement. Moreover, shipments during the month from Straits to London have only been 75 tons; from Australia to London, 1,000 tons; from Straits to America, 575 tons; total, 1,650 tons, as against deliveries in London, 1,652 tons; Holland, 584 tons. Under these circumstances the decline must be attributed to purely financial reasons.

Copper.—The deliveries in England and France in November amounted to only 3,983 tons, as against 7,747 tons in October, 9,145 tons in September, and show a smaller amount than in many previous years. Should other similar deliveries have to be reported in December, a considerable decline would be inevitable. This, however, is not probable, and it is anticipated in many quarters that the December deliveries will be all the heavier. The total of our supplies for November for England and France was moderate, viz., 5,708 tons (consisting of charters from Chili, 2,550 tons; shipments from Australia, 650 tons; imports of furnace stuff other than Chilian, 2,293 tons, and sundries 210 tons). The visible supply for Europe shows an increase for the month of 1,700 tons, and amounts to 48,529 tons, as against 46,809 tons a month ago, 50,217 tons on 1st December, 1881 (price £67); and 62,229 tons 1880 (price £61 14s.). The market closes at £56 10s. to £66 for cash; bars, good ordinary brands, cash, or £1 10s. lower for the week.

Speller is rather quiet. Ordinary Silesian at £16 15s. to £17.

Lead lower. English common brands, £14 2s. 6d. to £14 5s.; Spanish, without silver, £15 10s.

REPORT ON DIFFERENT SYSTEMS OF SEWAGE DISPOSAL.

BY MR. C. F. HANCOCK MEM. LOCAL BOARD, HENDON, ENGLAND.

We have to acknowledge the receipt of a copy of the above giving the results of a brief inquiry into the question with reference to the requirements of the town of Hendon, England. It contains a number of letters written by municipal officers and others on the success of the following different systems: The pail system, as used in Rochdale; the irrigation system, as used at Bedford, Leamington, Methyr, Tydfil, Croydon, Wrexham and Hitchin; the precipitation processes known as the A. B. C.; the Lime, Fritz Hillé's, Goodall's, Henson's, Bird's, Gotto & Beesley's, and that of the Rivers' Purification Company.

The territory was found to be too expensive to employ irrigation, it was then recommended to adopt the process of the Rivers' Purification, not because it was much superior to the others, but because the company, in consideration of an annual payment, proposes to operate the works to satisfy the conditions of the Rivers Pollution act and the local ordinance with regard to the quality of the effluent and indemnify the corporation against all proceedings, which together would obviate the necessity of the town having to raise a large capital, and relieve it from all responsibility.

* * *

AN invention which it is believed will effect important changes in the metal trade has recently been patented in Great Britain and most foreign countries, and is now being sold as an article of commerce. The invention consists of a new method of manufacturing alumina, by which nine-tenths of the present cost is saved, while it can be made in immense quantities in the course of a few days, instead of requiring nine months to produce it, as was formerly the case. The inventor is Mr. Webster, of Hollywood, near Birmingham, England, who has been engaged in the experiments since 1851, and only succeeded in perfecting his process about twelve months ago, after having expended nearly $150,000 in the experiments.

CORRESPONDENCE.

WALLINGFORD WATER-WORKS.

CHICOPEE, Mass., Dec. 18, 1882.

EDITOR ENGINEERING NEWS:

On Saturday, the 16th, the citizens of the Borough of Wallingford, Conn., celebrated the completion of their new system of water-works by a public exhibition and test, that was in every way satisfactory.

The exercises were in charge of the fire department of the Borough. They first attached 150 ft. of rubber-lined hose to a hydrant on the "Hill," where the pressure is 104 lbs. per square inch, and with an 1⅛ in. ring-nozzle, threw a vertical stream of 115 ft.; two other streams were then added, each of which threw a vertical height of about 100 ft. A much better result would have been attained had it not been for a sharp northwest wind that caused the stream to break badly. The next trial was with 50 ft. of hose and 1 in. ring-nozzle, attached to a hydrant on the "plains," where the pressure is 135 lbs. per square inch, which threw a vertical stream of 155 ft., easily going over the cross on the lofty spire of the Catholic Church. Other trials followed that were equally satisfactory, and which proved conclusively that the new works were capable of furnishing an abundance of powerful fire streams.

After these trials the fire department gave their guests an elegant dinner in the town hall.

Representatives of the departments from Hartford, New Haven and Meriden were present, and they, as well as the citizens, expressed themselves as well pleased with the new works.

The source of supply is Lake Pistanpaugh, lying in the southeast corner of the town, and 4½ miles from the center of the borough. It has an area of 164, and shed of about 400 acres. Its depth through the center is 26 ft.

On the north and east it is enclosed by precipitous mountains of trap formation, thickly wooded, while on the south and west are rugged hills used for grazing purposes. The water is exceptionally pure and soft, and abundant for the use of a place many times as large as Wallingford.

The water enters the gate house through an 18-in. conduit, 11 ft. below high water, that extends into the lake to where the water is 17 ft. deep. The gate house is of substantial stone and brick masonry, provided with waste-pipe, by-pass pipe, screws, weils, etc. From the gate house a 12-in. cast-iron pipe leads towards the borough, after passing the summit, where it is laid in a tunnel 1,000 ft. long and 80 ft. below the surface, it is reduced to 10 in., and afterwards to 8 in. just before it enters the Borough. This main line is provided with blow-offs and air-cocks at proper points.

Through the streets of the Borough the pipes are 8, 6 and 4 in., all of cast-iron, laid at a uniform depth of 5 ft.

The system embraces 57,000 ft. of pipe, all sizes, 58 double nozzle hydrants, 40 gates and 6 air-cocks.

Work was commenced about Aug. 1, 1882, and finished Dec. 8. The entire works were constructed by W. C. McClallan, of Chicopee, Mass., under the personal supervision of himself and his engineer, A. H. Howland.

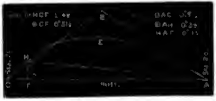
The Commissioners having charge of the works are Dr. B. F. Harrison, H. B. Todd and W. A. Ives. Surveys and plans were made by John Osborn, C. E., of New Haven, Conn. A.

SPIRAL CURVES.

Denver, Col., Dec. 13, 1882.

Editor Engineering News:

I cannot agree with Mr. Fry that his spiral curve *A E C* (see figures), gradually increasing in curvature from *A* to *C*, can have tangents *A B* and *C B*, which, with the chord *A C* as base, will form an isosceles triangle. If *A* represent sta. 20 and *C* sta. 21, then by his method the angles *B A H* and *B A C* are the last two deflections from the tangent *A B*, and are respectively 39½ and 51½ minutes.



H and *C* mark the positions of the last two 10-ft. stations, and the angle $C A H = 51\frac{1}{2} - 39\frac{1}{2}' = 12'$. $C F = 10$ ft. along the chord and $F A = 90$ ft.: Then $H\ F = 90 \times \tan.\ 12' = 90 \times .00349 = 0.314 +$ and of course tan. of the angle $H C F = 0.314 \div 10 = .0314$: this number is the tan. of 1° 48′. The angle *H C F* having a common side (*C F*) with the smaller angle *B C F*, the line *C B* must fall inside of the triangle *A H C*: as *A*, *H* and *C* are three points on the curve, the line *C B* must cut the curve and cannot be tangent to it.

In case it should be objected that the curve is not obtained by offsetting from 10-ft. stations along the chord *A C*, I will call attention to the fact that the result regarding the angles *H C F* and *B C F* will differ less than one minute from the result expressed in the figure, if either the chord *A H* or the curve *A E H* is assumed to be 90 ft. and *H C* to be 10 ft. I do not think I have misunderstood Mr. Fry's method of laying out the curve, his language seems quite plain; he says, "Set up the transit at station 20, and for each 10-ft. station of spiral deflect from the tangent," etc., giving the angles to be deflected, of which 39½ and 51½ minutes are the last two, and then says, take the back sight from *C* on *A*, turn 51½ minutes, and the line of collimation will be tangent to the spiral.

S. E. Reaugh.

S. P. R. R., New Germantown,
Perry Co., Pa., Dec. 17, 1882.

Editor Engineering News:

In laying out circular curves there is an error in measuring chords, instead of measuring round the curve, which is not practical.

This error decreases in proportion as the length of the chords measured diminishes.

In practice the error of measuring 100 ft. chords is so small that it is used as a standard.

In the spiral curve, as demonstrated in your issue, No. 10, of this year, the error, as shown by Mr. Haynes, is 0.15 ft.

This error can be diminished by increasing the number of stations in the spiral, and if it were possible to lay out a spiral with an infinite number of stations the error would be diminished to zero.

If 0.15 ft. is considered practically too large an error, the 100 ft. spiral may be laid out with 20 stations. Yours truly, W. H. Fry.

ENGINEER'S BOOK OF TABLES.

Pennsylvania Railroad Company,
Office of Superintendent of West Pennsylvania Division,
Blairsville, Pa., Dec. 18, 1882.

Editor Engineering News:

Your "Engineer's Book of Tables for Railway Construction" at hand, and am much pleased with it. Enclosed find Five (5) Dollars, for which send me five (5) copies of same as early as convenient.

Yours truly, H. W. Edwards, C. E.

[The "Engineer's Book of Tables" was not prepared as a book to sell. For the convenience of the Engineer Corps of the West Shore Railroad those tables were completed and afterwards put in octavo pages and lithographed. They are, therefore, practical memoranda for practical working purposes, and as such the pamphlet recommended itself to us. We got permission to issue a small edition, and at present writing that edition is already half sold. The price is placed at the convenient one of one dollar, and if letters are carefully sealed and addressed we do not think it is necessary to register them. A letter failing to reach us is a rare exception.—Ed. Eng. News.]

THE LONGEST TANGENT—C. & N. W. RY.

Winona & St. Peter Railroad Co., and
Dakota Central Ry. Div., Engineer's Office,
Winona, Minn., Dec. 16, 1882.

Editor Engineering News:

Referring to request of R. P. A. in Engineering News of Dec. 9, for the "longest tangent on an operating road," would say that there is one 54 miles in length on the Dakota Division of the Chicago & Northwestern Railway. Yours truly,

Jno. E. Blunt, Engineer.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 429.)

CCCCXXXIX.—YOUNGSTOWN, O.

Youngstown, Ohio, in lat. 41° 7′ N., long. 80° 37′ 45″ W., on both sides of the Mahoning River, is on hilly ground, rising abruptly on the north side and more gradually on the south side from the river level to a height of 175 ft.

It was incorporated in 1848 as a village and in 1867 as a city.

Water-works were built for the city in 1872 by the Holly Manufacturing Co., taking the supply from the Mahoning River, which drains 950 square miles.

The water is received in a well on the river bank, and pumped directly into the mains by Holly upright piston pumps driven by a steam engine. Two rotary pumps were also used for giving fire pressure. These were replaced in 1880 by a Worthington duplex pump of 3,000,000 gallons daily capacity. The ordinary pressure maintained is 75 lbs., and the fire pressure 100 to 150 lbs. at the pumps. The highest point to which water is distributed is 170 ft. above the river.

Distribution is by 15 miles of cast-iron pipe of from 15 to 4 in. diameter, with 111 fire hydrants, 168 gates and 882 taps. There are 15 meters. Service pipes are of lead.

The population in 1880 was 15,431. The daily consumption in 1881 was 800,000 gallons.

The works cost $175,000. The bonded debt is not stated. The receipts to Feb. 28, 1882, were $91,957.15. The expenses in 1881 were $9,388.41, and the receipts $14,026.31.

The works are managed by three trustees, one being elected annually. George Rudge is the Secretary and W. S. Hamilton the Superintendent.

CCCCXL.—SALEM, N. J.

Salem, New Jersey, in lat. 39° 32′ N., long. 75° 30′ W. is on flat, sandy ground on Salem Creek, near Delaware Bay.

Settled in 1675, it was incorporated as a city in 1858.

Water-works were built by the city in 1882, after plans of Isaac S. Cassin, C. E., taking the supply from Laurel Run, a stream of about 5 square miles water shed. An earthen dam 280 ft. long, forms an impounding reservoir on the stream, holding 42,000,000 gallons. The dam is founded on solid bottom, 12 ft. below the natural surface. It is 15 ft. wide on top and has inside slope of 3 to 1; and outside of 2 to 1. The overflow is carried under the bank by a 6-ft. conduit.

A 12-in. cast-iron pipe conveys the water 4 miles to the pumping station, whence it is pumped directly into the mains by a Holly Steam Engine of 1,500,000 gallons daily capacity. The ordinary pressure is 35 lbs., and the fire pressure 110 lbs.

Distribution is by 9 miles of cast-iron pipe of from 12 to 4 in. diameter, with 56 fire hydrants, and 33 gates.

There is no account of the taps. Service pipes of lead and of galvanized-iron are used.

The population in 1880 was 5,500. The daily consumption is supposed to be 100,000 gallons. The works have recently gone into operation.

The cost of the works is $77,000. The bonded debt is $75,000 at 5 per cent. interest.

The Mayor, Charles Lawson, is chairman of the Water Committee. Charles W. Casper is the Superintendent.

CCCCXLI.—NEWCASTLE, DEL.

Newcastle, Delaware, in lat. 39° 40′ N., long. 75° 35′ W., is on flat, sandy ground on the Delaware River.

Settled in 1600, it was incorporated as a city in 1878. Water-works were built by a private company in 1670, after plans of Isaac S. Cassin, C. E., taking the supply from the Christiana River, 4 miles west of the city.

A 16-in. conduit, 400 ft. long, conveys the water from the river 100 ft. from the shore, to the pump well, whence it is lifted 96 ft. by a Henderson duplex engine of 500,000 gallons and a Blake pumping engine of 750,000 gallons daily capacity, to a reservoir built in excavation and embankment, holding 1,500,000 gallons at 92 ft. above the city.

Distribution is by 8¼ miles of cast-iron pipe of from 12 to 4 in. diameter, with 40 fire hydrants, 35 gates and 507 taps. The city does not pay for fire service.

Lead service pipes are used.

The population in 1880 was 4,800. The daily consumption in 1881 was 450,000 gallons.

The capital stock of the company is $50,000. The works have cost $100,000. The bonded debt is $50,000 at 5 per cent. The expenses in 1881 were $2,500, and the receipts $8,000.

James G. Shaw is the President, and Isaac C. Shaw the Superintendent.

CCCCXLII.—BRAMPTON, ONT.

Brampton, Ontario, in Canada, in lat. 43° 40′ N., long. 79° 50′ W., is on slightly undulating ground on the Etobicoke River.

Settled in 1837 it was incorporated as a town in 1878.

Water-works were built by the town in 1881-2 after plans of Louis H. Knapp, C. E., taking the supply from Snells Lake, which is 4½ miles from the town and 120 ft. above it, has an area of 45 acres, and a water shed of 700 acres.

The water is taken from the lake through a crib of timber filled with gravel, and conveyed to the town in a 12-in. cast-iron pipe.

Distribution is by 3 miles of cast-iron pipe of 8 and 6 in. diameter, with 41 fire hydrants, 15 gates and 50 taps. Lead service pipes are used.

The population in 1880 was 3,500. The daily consumption is now 75,000 gallons.

The works have cost $58,000, which is the amount of the bonded debt at 5 per cent. interest. The works have only recently gone into operation, and the expenses and receipts can not be determined. The management is vested in a committee of the town council. M. M. Elliott is the Chairman.

CCCCXLIII.—BURLINGTON, VT.

Burlington, Vermont, in lat. 44° 30′ N., long. 73° 15′ W., is on ground sloping upward from the shore of Lake Champlain to an elevation of 300 ft. Settled in 1773, it was incorporated as a city in 1865. The University of Vermont was founded here in 1791.

Water-works were built in 1867 by the city after plans of William S. Whitwell, C. E., taking the supply from Lake Champlain and pumping it by two Worthington duplex steam pumps, each of

Google

750,000 gallons daily capacity into a reservoir 200 ft. square and 13 ft. deep, in excavation and embankment, 280 ft. above the lake.

Distribution is by 20 miles of pipe of from 10 to 3 in. in diameter. Cement-lined wrought iron pipe was at first used. Cast-iron is now used and is being substituted for the cement-lined in the lower part of the city.

There are 148 fire hydrants, 175 gates, 1,785 taps, and 90 meters. The city contributes $1,200 per year for hydrant service. Service pipes are mostly of galvanized-iron and some of lead.

The population in 1880 was 11,371. The daily consumption in 1881 was 593,881 gallons.

The works have cost $440,000. The bonded debt is $130,900, at 5 and 6 per cent. interest. The expenses in 1881 were $7,627.25, and the receipts $22,407.21.

The works are managed by a committee of the City Council. A. Adsit is the Superintendent.

CCCCXLIV.—LA CROSSE, WIS.

La Crosse, Wisconsin, in lat. 44° 45' N., long. 91° 15' W., is on the Mississippi River. The La Crosse and Black rivers flow through the city, emptying into the Mississippi. The central part of the city on both sides of the La Crosse is on low meadow land, north of which is a plateau 20 ft. above the river, and on the south is a plateau of 40 ft. elevation.

A trading post was established here in 1842. The village was laid out in 1851, and incorporated as a city in 1856.

Water-works were begun in 1877 by the city, after plans of H. I. Bliss, City Engineer. The first works consisted of about 8 miles of pipe for the supply of the business part of the town and fire protection in other parts, and the pumping was done by mill owners under a contract with the city. Pumping works were built by the city in 1880–81, taking the supply from the Mississippi River through a 16-in. cast-iron pipe 600 ft. long, of which 178 ft. is submerged and laid with flexible joints. A Blake duplex steam pump, with 30-in. steam, and 16-in. water cylinders pumps directly into the mains, with 65 lbs. ordinary pressure at the pumps, making 45 lbs. in the city. The fire pressure is 115 lbs. at the pumps. It is intended to erect in 1881 a stand pipe 4 ft. in diameter and 210 ft. high.

Distribution is by 8½ miles of cast-iron pipe of from 16 to 4 in. diameter, with 85 fire hydrants, 80 gates and 425 taps. Service pipes are of galvanized iron. There is also in the Fifth Ward, formerly the village of North La Crosse, 1½ miles of 6-in. pipe, with 10 fire hydrants, supplied by a Blake duplex pump, owned and operated by the owner of a steam saw mill, under a contract with the city.

The population in 1880 was 14,505. The daily consumption in 1881 was 600,000 gallons.

The works have cost $90,000. There is no separate water-works debt. It is estimated that about $20,000 of the money raised from city bonds, has been expended on the water-works.

The expenses in 1881 were $6,500 and the receipts $4,000.

The works are managed by the Water Committee of the Common Council. James Manchester is the Superintendent.

CCCCXLV.—RATON, N. M.

Raton, New Mexico, in lat. 36° 50' N., long. 104° 40' W., is on a plain, 3 miles from the foot of the Raton Mountains. It has grown up since 1879, as the site of the machine and repair shops of the Western & New Mexican divisions of the Atchison, Topeka & Santa Fe Railroad.

Water-works were built by the Railroad Company, after the plans of A. A. Robinson, C. E. The works have been, during 1882, transferred to the Raton Water Company.

Springs on the mountain, 3½ miles from and 1,200 feet above the town, furnish 50,000 gallons a day, which is conveyed to the town by a 2 in. wrought-iron pipe over very broken ground.

A well has also been dug a mile from the town on the bank of Raton Creek, the water from which is pumped through 8,000 feet of 8-in. cast-iron pipe to a reservoir on high ground north of the town, now in course of construction. The gravity and pumping systems are connected, the pump being run only as needed.

Distribution is by 2 miles of 6, 4, and 2 in. pipe. The number of hydrants and taps is not given.

The works have cost $40,000.

TO BE CONTINUED.

The receipt of statistics as follows is acknowledged with thanks:

From Isaac S. Cassin, C. E., statistics and water rates of Salem, N. J., Water-works.

From M. M. Elliott, Chairman Water Committee, statistics of water-works of Brampton, Ont., Can.

From George Rudge, Secretary, statistics of the water-works of Youngstown, O.

From A. Adsit, Superintendent, statistics and water rates of Burlington, Vt., Water-works.

From Henry I. Bliss, City Surveyor, statistics of La Crosse, Wis., Water-works.

From W. E. McDermott, Clerk to Water Trustees, and also from L. Laubscher, C. E., statistics to date of Fort Wayne, Ind., Water-works.

From W. G. Sawyer, C. E., account of Raton, N. M., Water-works.

From A. M. Johnson, President Lookout Water Co., statistics of Chattanooga, Tenn., Water-works.

From G. Kendlehart, Superintendent, statistics of Gettysburg, Pa., Water-works.

* * *

BIDS FOR PUMPING ENGINES FOR NASHVILLE, TENN.

Bids for new pumping machinery were opened by the water-works commission on the 11th. There were bids from eight firms and in nearly every case different proposals from the same firm. The proposals were for machinery as described in the original specifications, and also supplemental and additional specifications as afterward adopted when the bidding was invited for the second time.

In our issue of Oct. 28, 1882, we published a synopsis of the specifications, and in order that the bids may be understood we publish the additions:

1. For pumping machinery to work under the conditions as set forth in original specifications to which this is attached.

2. For three or more pumping engines, each having an easy capacity to pump 5,000,000 gallons of water per twenty-four hours under the conditions as set forth in said original specifications.

3. Two pumping engines, each with a capacity to pump 5,000,000 gallons per twenty-four hours, from the Cumberland River, as provided in said original specifications, into the low service reservoirs, the flow line of which will be about 180 ft. above low water in said river. And one or more engines, each capable of pumping 5,000,000 gallons per twenty-four hours from the Cumberland River, above described, into the high service reservoir, the flow line of which will be 280 ft. above low water in said river.

4. For two or three pumping engines to be placed in present engine pit, the lower floor of which is approximately 21x30 ft. and about 20 ft. above low-water line in the Columbia River—said engines to have an easy aggregate capacity to pump 15,000,000 gallons of water into the low service reservoirs as above, taking water through two 36-in. suction pipes; also, one or more pumping engines, each capable of raising 5,000,000 gallons of water from said low service reservoir, against a head of 100 ft.

Steam pressure in boilers during duty will be maintained at not over 70 pounds per square inch.

The right is hereby reserved by the City Council to reject any and all bids, or to accept such as in their judgment will best subserve the interests of said city.

Reference being had to the annexed specifications for forms of proposals, together with other stipulations and conditions not herein specifically set forth.

J. B. ROMANS & CO, OF NASHVILLE, TENN.,

submitted detailed proposals to furnish two ten million gallon engines as per specification No. 1, for the sum of $180,000.

O. A. LIBBY & SON, JANESVILLE, WIS.,

submitted three separate proposals, the first of which was as follows:

As per specification No. 1, two ten million gallon engines	$124,000
As per specification No. 2, three five million gallon engines	120,000
As per specification No. 3, low service	38,000
Same, high service	116,000
As per No. 4, low service	83,000
Same, high service	10,000
As per No. 4, aggregate	99,000

Duty on No. 1, 100,000,000 foot pounds per 100 pounds of coal used for the short test, and 85,000,000 for long; all other, 92,000,000 and 82,000,000 respectively.

Messrs. Libby & Son's second proposal was as follows:

Aggregate No. 1	$130,000
Capacity	130,000
All of No. 2	130,000
All of No. 3	117,000
All of No. 4	113,000

Duty 92,000,000, and 80,000,000 short and long test respectively.

Messrs. Libby & Son's third proposition:

All of No. 1	$130,000
All of No. 2	126,000
All of No. 3	122,000
All of No. 4	103,000

Duty 100,000,000 and 85,000,000 respectively for long and short test.

CLAPP & JONES, HUDSON, N. Y.

All of No. 1	$190,000

Duty 65,000,000 gallons.

S. H. MARTIN, CLEVELAND, O.

All of No. 1	$90,000
All of No. 3	62,050
All of No. 4	123,000

Duty, 80,000,000 and 70,000,000 respectively.

WEST POINT FOUNDRY, COLD SPRING, N. Y.

All of No. 1	$307,000
Two five-million engines, high service, as per No. 2,	143,000
All of No. 4	270,000

Duty, 65,000,000.

E. P. ALLIS & CO., MILWAUKEE, WIS.

All of No. 1	$173,850
All of No. 2	144,000
High service No. 3	48,000
Low service No. 3	30,500
All of No. 3	135,500
Low service No. 4	104,000

High service No. 4, $27,500 and $23,250.

All of No. 4, $131,500, or $127,250.

Duty on ten million gallon engines, No. 1, 98,000,000 and 70,000,000.

Duty on five millions, Nos. 2 and 3, 95,000,000 and 74,000,000.

Duty on No. 4 (seven and a half millions), 80,000,000 and 64,000,000.

Messrs. E. P. Allis & Co., also submitted another proposition, as follows:

All of No. 1	$173,850
All of No. 2	127,500
All of No. 3	120,300
All of No. 4	127,250

HARTFORD IRON WORKS, HARTFORD, CONN.

All of No. 1	$231,000
All of No. 2	195,700
All of No. 3	187,600
All of No. 4	225,000

H. R. WORTHINGTON, NEW YORK.

All of No. 1	$80,000
All of No. 2, four-foot stroke	112,000
All of No. 2, three-foot stroke	90,000
All of No. 3, four-foot stroke	70,000
All of No. 3, three-foot stroke	63,700
All of No. 4	65,000

Duty, 50,000,000.

COPE & MAXWELL, HAMILTON, OHIO.

All of No. 1	$156,000
All of No. 2	144,000
High service No. 4	16,000

Duty, 65,000,000

HOLLY MANUFACTURING COMPANY, LOCKPORT, N. Y.

Vertical engines:

All of No. 1	$180,000
All of No. 2 three engines	135,000
All of No. 3	134,000
Three engines No. 3	134,000
Four engines, No. 3	174,000
All of No. 4	145,000

Duty 90,000,000 based on ten pounds water evaporated in the boilers per one pound of coal, or 72,000,000 on eight pounds of evaporation.

Horizontal engines:

All of No. 2	$128,000
All of No. 3—three engines	105,000
Or all of No. 3—four engines	140,000
All of No. 4	125,000

Duty 100,000,000 on ten pounds of evaporation or 80,000,000 on eight pounds.

The last-named firm agreed to take water-works bonds at par in payment.

The bids were referred to Capt. J. D. Cook, consulting engineer, for a report.

* * *

HOW IRON FILINGS PREVENT THE USE OF THE ELECTRIC LIGHT.

A case wherein the electric light and small particles of iron and steel are the central figures of attraction has lately come to light in this city. A manufacturer who employs a large number of emery wheels in his works concluded that he ought to have an electric light, and the light was accordingly put in. To his great disappointment he found that it would not work, and as an explanation for its queer conduct, was informed that the light was all right, but the atmosphere of the shop was all wrong—there were too many iron and steel filings "a flying in the air." After several ineffectual efforts to make the light perform its functions properly, it was suggested that the generator might be "boxed" and the obnoxious filings kept at a distance. This plan was tried, but without favorable results. The generator got hot, and petitioned very forcibly and effectually for a few whiffs of fresh air. This ended the struggle and the light was taken out. The real cause of the light's failure, as we have intimated, was not due to any imperfections of its own, as it is now working satisfactorily at another shop, but is ascribable to the large amount of iron and steel filings and dust in the air of the shop in which it was so fruitlessly experimented with. The rapid travel of the armature of the generator created a suction in the air, and this, added to the magnetism of the field magnets, naturally drew all iron filings floating in the air toward and into the machine. These small particles, attaching themselves to the armature strips, were brought in contact with the electric sparks of the machine and heated sufficiently to burn out the sections of the armature. The loss of one section, of course, breaks the circuit and puts an end to further operation. Several sections were burned out in the experiments to which we allude and the folly of persisting fully demonstrated. The question now is, can the electric light be successfully employed in close proximity to emery wheels?—*Age of Steel.*

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR..............ASSOCIATE EDITOR.

SATURDAY, DECEMBER 23, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6 50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
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St. Nicholas Magazine	2.55	3.00
North American Review	4.00	5.00
Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do his we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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NOTICE OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 127 East Twenty-third street, New York. The thirtieth annual meeting of the society will be held in New York, on Wednesday, Jan. 17, 1883, at 10 A. M. The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, proposed amendments to the constitution discussed, and other business transacted. Arrangements for Jan. 17 and 18 will be perfected by a committee, and you are invited to be present at the meetings on those days.

THE OHIO STATE ASSOCIATION OF SURVEYORS AND ENGINEERS.—The third annual meeting of the above Association will be held in Columbus, Ohio, on Jan. 17, 18, 19, 1883. There is every reason to believe that there will be a very full attendance of the surveyors and engineers of the State, and that the meeting will be of great interest and value. Parties expecting to attend the meeting will do well to notify early the Secretary, Benjamin Thompson, Urbana, Ohio.

THE JOURNAL OF THE ASSOCIATION OF THE ENGINEERING SOCIETIES for November is entirely devoted to two papers, one by Prof. Geo L. Vose on "The Training for Students in Civil Engineering," and the other by Thos. W. Fitch, member of the St. Louis Club of Engineers, on "Steel Methods and Manufacture—The Bessemer and Basic Processes."

THE SCHOOL OF MINES QUARTERLY, published by the Alumni Association of Columbia College, for November contains, among other valuable articles, the following: "Some Notes upon the Berlin Stadtbahn, or City Elevated Railroad, and the Ringbahn, or Belt Railroad," by J. A. Navarro; "Notes on River and Harbor Surveys," by Thos. H. Leggett; "Improvement of the Wisconsin and Fox Rivers," by Stancliff B. Domes," and "Professional Notes." This very valuable magazine is now in its fourth year. The subscription price is $2, or fifty cents per number, and all communications should be addressed to "School of Mines Quarterly," 49th street and Fourth avenue, New York City.

THE PANAMA CANAL.—Mr. Charles Colné will deliver a lecture on the Panama Canal in Steinway Hall on the evening of January 4, under the auspices of the General Society of Mechanics and Tradesmen of this city. This lecture will be illustrated as fully as possible, and will be a general description of the principal features of the canal, citing what has been done, what is being done, and what will be done. A statement of the facts in regard to the project by one thoroughly conversant with the intentions of M. de Lesseps and representing the company in this country, will be received with pleasure by engineers, and with studious attention by those who have busied themselves over certain political points.

* * *

THE PHILADELPHIA WATER DEPARTMENT.

The selection of a Chief of the Water Department still agitates the minds of the City Fathers of Philadelphia. In its latest phase they seem to weary of the task set them, and now desire to shift the responsibility of the selection of a proper person for the office upon the shoulders of some other body than their own. A resolution was presented to Councils, proposing that in connection with an increase of salary, the candidates be subjected to a competitive examination by a Board chosen by the Faculty of the Towne Scientific School Uni. of Pa., the Franklin Institute, and the Amer, Soc. C. E. The Amer. Soc. has already placed itself on record as declining to interfere in any such matters; and now we see by the *Philadelphia Record* of Dec. 18, that the Franklin Institute have expressed an opinion that an examination would not properly develop the fitness or unfitness of a person for the office; it would be theoretical only, and would be no fair test of the executive ability of the candidate. Curiously enough, in the resolution above referred to, two very important requirements for the position in question are omitted, viz., *Hydraulic Engineering* and the *practical management* of so important a department. To the minds of those at a distance, unbiased by the petty wranglings of short sighted and unwise politicians, the executive ability to handle so vast a system as the water supply of the second city in the Union, is of paramount importance, and a study of the official reports of the Philadelphia Department, show that Dr. McFadden can be charged with no lack of such ability, when we compare the results attained with the money expended—and to the taxpayer this is, after all, the crucial test. In the Department reports for 1881, a very complete table sets forth the "itemized expenditures of the Department, since consolidation, from annual and special appropriations," and a summation of this table shows that while from the years 1867 to 187[illegible] an expenditure of $4,366,877.22, provided means for only an increased daily supply of 7,438,478 gallons, an expenditure of $4.691,121 83, between the years 1873 and 1881, which period represents Dr. McFadden's management, gave the consumers an increased supply of 26,510,895 gallons per day; or, to put it more plainly, Dr. McFadden with *one dollar* expended gained the same practical results that cost his predecessors almost *four dollars*. For the nine years of his administration the same report of 1881 shows that the receipts in *excess* of expenditures, average $563.000 per annum, and for the last four years they average $1,000,000 per annum. In a private business we would call this a most excellent showing of profits, and would applaud the man whose business tact was equal to the realization of such results.

Now, as to the engineering qualifications of Dr. McFadden to fit him for his position, we really think that little remains to be said after the foregoing statements. The most successful engineer, and the one whose services are most in demand by the corporation that furnishes the money, is he who can accomplish the most with the least expenditure.

But it seems that the present chief has other recommendations than this. In 1875 a commission of experts was appointed to examine into the water supply of Philadelphia; a commission made up of such representative engineers as William J. McAlpine, Julius W. Adams, W. Milnor Roberts, Solomon W. Roberts and W. E. Morris (acting in connection with Chief Engineer McFadden.)

In reading their report we find this body of eminent experts in more cases than one, simply endorsing the suggestions of Chief Engineer McFadden, one of the most important of which was his division of the city as it now stands into "systems" regulating the supply by the requirments of the district. This system the experts endorse as "very complete," and in this connection we might state that to this division of the city into systems we are all indebted for a very excellent topographical map, the first ever published of Philadelphia. A later Board of Experts, appointed in June 1882, and made up of such noted engineers as E. S. Chesbrough, Frederick Graff and J. V. Merrick, have also just filed a report, a copy of which lies before us, and in comparing their "suggestions" with the Department report of 1881 we find that they too repeat and endorse the suggestion of Dr. McFadden, as to the building of the Cambria reservoir, the completion of the East Park reservoir, and the extension of the reservoir at Mount Airy. These "suggestions" have a familiar sound, and if our memory does not deceive us they have been printed from year to year for some time past in the Philadelphia reports.

From the report of the last named board and from the Department report of 1881 we can arrive at but one conclusion, which is not complimentary to the managers of the finances of our neighboring city, and it is, that these managers have used the profits of the Water Department in other public works, to the extent of "starving it out" and greatly endangering its usefulness. They have diverted the revenue, instead of expending some portion each year in extending the Department "plant" so as to meet in advance the requirements of a rapidly increasing consumption. The experts find that "the existing machinery is worked to its utmost capacity;" that "at the two largest steam works there is no spare machinery;" that "at certain periods, which are also those of greatest consumption, the water power at Fairmount is practically unavailable;" and they also find "that, at the rate of annual increase in largest consumption of the past year (which is about eleven million gallons daily) there will not be enough pumping power to sufficiently supply, during the driest seasons of next year (1883), an area which contains two-thirds of the population, while in 1884 there will be a short supply throughout almost the whole city."

This is an alarming state of affairs for a community and with all due deference to the Councils of Philadelphia, we think that it would be ill advised "to swap horses while crossing the stream." If a new man was suddenly placed at the head of so vast and intricate a system as that in question, even had he passed his examination as a "civil engineer," without the familiarity with all the working and requirements of the Department that time alone could supply, and marked executive ability, he would find his charge in the condition of the "deacon's one-horse chaise," and the good people of Philadelphia would find themselves without water when they needed it most.

IRON TRADE INDICATIONS.

The decline which has taken place in steel rails, from $45 to $40, and, according to recent quotations, to $39, has had the effect of increasing the demand for rails, as is evidenced by the placing of contracts which, according to announcements made in trade papers, will fall very little short of 250,000 tons, within a little more than thirty days. The amount may be larger than this, as both buyers and sellers are unusually reticent as to transactions and prices. It was stated months ago that orders were withheld from the market because of the expectation on the part of buyers of a decline in prices, and that a decline was in progress which would reduce quotations within a few months. That result has been reached and the orders have been placed. It is impossible to predict with any degree of certainty the future course of the Bessemer steel prices. The productive capacity has reached a limit at which an enormous demand will be necessary to sustain prices a little above cost limits. Whether railroad building will be prosecuted with that activity which has characterized the past year is a question which none can answer. There is no reason to take the pessimists view of the situation, and conclude that because we have built 105,000 miles of road that we will therefore stand stock still and build no more. There is no apparent reason why the great activity which has characterized railroad building should not continue, and that the spirit of enterprise which has aroused the latent energies of the American people during the past 13 years should continue to call for additional railway construction, not only in the remote sections of the west and south but in the states between the Atlantic and Mississippi River. The decline in the cost of rails stimulates demand, specially when buyers are satisfied that bottom prices have been reached for the present. What the bottom prices of the future are is a matter of conjecture. If the expectations of inventors engaged in metallurgical problems are realized a further reduction in cost of $10 per ton is probable. Certainly, some cheapening of cost is near at hand. A patent has been recently granted for a process of manufacturing iron and steel direct from the blast furnace wherein great economy is realized. A portable converter is used in the furnace which can be made to hold any desired amount of metal to be treated. Two converters can be used time about, thus continuing the steady treatment of metal without stoppage. This is an improvement upon the Basic process, which promises to be rapidly adopted. The patentee has granted licences to about a dozen companies, and they are now engaged in putting in the necessary machinery. By this process it is claimed that merchant iron, plates, sheets, nails, spikes, hoops and structural shapes can be made better and cheaper than by the present method. The improved method dispenses with the casting houses at the blast furnaces, the cupola, the hoist and other necessary appliances and it will use the heat of the blast furnace to raise all the steam required for rolling, etc. The inventor claims that $10 is the minimum saving which can be effected. If so, it would not be surprising to see steel rails made at $30 per ton, and merchant bar made at least 25 per cent. below its present cost of production. We are certainly on the eve of a radical departure in methods of manipulating iron and steel. Foreign inventors and metallurgists are engaged on the same problem and wonderful advancements are being made in that direction. They have already applied their improvements to blast furnaces and have produced iron that has stood severe tests. Of course all these methods will be severely criticised, but it is only a question of a very short time when manufacturers will be obliged to reject the old and accept the new.

The iron interests have agreed to quietly accept the proposed reductions of iron and steel, but they do so with some unwillingness because of the serious difficulties in the way of paying present cost of labor and material at present market prices. They are unwilling to reduce wages, but with the adoption of the proposed reductions they see no other course before them except to economize in this direction. Steps have been taken already to lessen cost of labor to the extent of 10 per cent. in mills and furnaces in Pennsylvania, and it is probable that a general reduction will be made everywhere, excepting where scales control the rates of wages as is the case in Western Pennsylvania, and in nearly all the mills west of that point. Pig iron manufacturers request an advance from $7 to $8 in duties but the commission proposed a reduction of from $7 to $6. During the past year two, and in some cases three, advances of wages were made to blast furnace labor amounting to about 30 per cent. A reduction in this item of cost will be made with as little delay as possible. In the matter of lake ore a moderate reduction is desired, but it is difficult to bring about because of the unwillingness of ore miners to concede anything. The completion of railway facilities and the development of newly opened mines will be an argument, which will be more respected than the sentimental appeals of consumers. Lake ore should not be sold at $10 per ton at Cleveland, when it costs less than half that to deliver it there. Some Bessemer rail companies have purchased their own mines and with the assistance of importations the cost of rail-making will be considerably reduced during the next twelve months in the matter of cost of ore. It is expected with the expansion of facilities for using the water communication between the lakes and eastern shipping points that lake freights will be reduced. As to cost of coal less can be said. The anthracite combination will when necessary restrict production to maintain prices at something near present limits. The heavy demand for soft coal will not permit of any vigorous effort upon the part of operators to depress wages. The demand for ore, coal and all the vast variety of manufactured products into which iron and steel enter will very probably be maintained during 1883 at the same volume as during the year now closing. The latest evidence as to future prospects unite in assuring the industrial and commercial interests that there will be no falling off in demand, no collapse in values, no restriction of consumption but on the contrary that there will be a healthy improvement in all these directions.

At a meeting of manufacturers of pig iron, bar iron, plate and sheet iron, and other kinds of iron in the states east of the Alleghenies, held in Philadelphia, Dec. 2t, it was decided to submit a statement to Congress expressing their satisfaction at the appointment of the Tariff Commission, and adding:

"While not approving of all the changes proposed by the Commission, we believe that in the main such reduction will not paralyze the industries to be effected by them." It is urged that prompt action be taken by Congress on the question of tariff revision, in order to dispel the feeling of uncertainty which prevails in the public mind and restores business confidence.

◆

THE SANITARY CONDITION OF SUMMER RESORTS.

> The season at Brighton, in England, has been a comparative failure this year. This is mainly due to an article which appeared in the *Lancet*, an English medical journal, making charges against the sanitary condition of the favorite Sussex resort. It is said that Brighton has lost this season the money which 20,000 visitors would have spent. This calculation is founded upon the falling off in the number of tickets sold by the railway company, and is probably not exaggerated. But injurious as the attack upon the sanitary condition of Brighton was, the action of the authorities was still more so. These wiseacres, instead of merely quoting the exceedingly low death rate of their town, began a suit against the *Lancet*, and started a "Brighton Defence Fund." The suit was dropped, but an excited controversy raged in the newspapers, the consequence being that many people deserted Brighton for Eastbourne and other resorts within an easy distance from London.—*N. Y. Sun.*

This scare was hardly called for, according to good authority, although the sewerage of Brighton is defective, and has been advertised as so. But the above is so closely a parallel case with that of Seabright and its vicinity, where a bold newspaper man last summer incurred the vengeance of the people for publishing some facts about the sanitary condition of his locality, and was very much harrassed by them, that we call attention to it. There is a difference, however, for whereas in the English watering place hardly any cause for fear existed, in our New Jersey resort there was such reason for complaint that it was made the subject of investigation by a grand jury, which resulted in sundry indictments. If proper sanitary precautions are not enforced at many of our crowded summer resorts in the mountains and by the sea, there will result to their proprietors something similar to the pecuniary losses detailed above. We spent two weeks at Atlantic City last season; the first four days were spent in wrestling with a severe attack of dysentery, which we found was a universal complaint; after recovery from that one realizes in walking about the crowded streets what a vile atmosphere he is inhaling from the odor which constantly arises from the thousands of privies that are never cleaned out, and the contents of which have saturated the whole site of the city. There are no sewers, and probably will not be until an epidemic has frightened off thousands of the annual summer residents of this otherwise very delightful resort.

◆

PERSONAL.

Robert H. Sayre having resigned from the positions of general superintendent and chief engineer of the Lehigh Valley Railroad H. **Stanley Goodwin** has been appointed general superintendent and A. W. **Stedman** chief engineer.

At the first monthly ballot of the session of the Institution of Civil Engineers **George E. Waring, Jr.**, Newport, R. I., was elected member, and **Thomas Alexander Wate**, of the Dominion Public Works Department was elected an Associate of the Institution.

Dr. Henry D. Denison, of Syracuse, died of pneumonia Wednesday. He was 60 years old. During thirty years he was contractor on public works, and during twenty years was a member of the firm of Denison, Belden & Co. He leaves $1,000,000.

Trenor W. Park died at sea on Wednesday, December 13, on the Pacific mail steamer San Blas while en route from this city to Aspinwall. Mr. Park was born near Bennington, Vt., in 1823, and there received preliminary education. In 1852 he went to California as chairman of the committee to investigate and settle the land titles to that State, and remained a resident until 1863. His ability at the bar was quickly recognized, and he was connected with every case of prominence during his residence. He returned to his native place, abandoned the legal profession and engaged in projecting and promoting railroad, mining and banking enterprises. He was largely interested in the Panama Railroad Company, of which he was president at the time of his death. He was a director for many years in the Pacific Mail Steamship Company, and was connected with many banking enterprises in the city. He was a director of the Hudson River Tunnel Company and was most sanguine of the ultimate success of that undertaking.

Mr. Albert Millet, a graduate of the Rensselaer Polytechnic Institute, for the last ten years Government Engineer for the republic of Ecuador with headquarters at Quito, and more recently Chief of the Technical Bureau of the Panama canal, has been spending the past week in this city, but sailed on Thursday for Panama. **Mr. Millet** has been awarded the contract for the Summit section of the Panama canal and will start the work of construction early in January. He has ordered 10 locomotives, 450 tons of steel rails, eight steam excavators, 300 dump cars, steam pumps and other contractor's plant. The depth of the cutting at the summit is about 392 ft. **T. M. Cleemann**, Member American Society Civil Engineers, of Philadelphia, is Inspecting Engineer of locomotives and rails for **Mr. Millet** and F. H **Baerman**, C. E., of Troy, N. Y., is Inspecting Engineer of excavators and dump cars. Osgood & MacNaughton build the excavators and Gilbert Bush & Co. build 100 of the cars. The locomotives are being built by three different firms. **Mr. Millet** is also a bidder for the construction of water-works at Panama and also at Guyaquil in Ecuador. His address is Panama, care of Interoceanic Canal Company.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The regular meeting of the Society was held on Wednesday, Vice-President Paine in the chair.

A paper by William P. Shinn, M. Am. Soc. C. E., on "The Increased Efficiency of Railways for the Transportation of Freight" was read and partially discussed. The discussion will be renewed at the annual meeting.

The next meeting of the Society will be held Wednesday, Jan. 3, 1883.

The annual meeting will be held Wednesday, Jan. 17, 1883, at 10 A. M.

The Library and Conversation Rooms are open each Wednesday evening, from 7:30 to 10 o'clock.

WESTERN SOCIETY OF ENGINEERS.

At the 160th meeting, Dec. 19, a paper on "Details in Ordinary Iron Bridges," by Mr. J. A. L. Waddell, was read.

NEW YORK WATER SUPPLY.

Commissioner Hubert O. Thompson, in his report to the Mayor of the operations of the Department of Public Works for the quarter ending on Sept. 30, 1882, says that the rainfall in the Croton basin in the quarter was $21\frac{18}{100}$ inches at Boyd's Corners reservoir, and $18\frac{81}{100}$ inches at Middle Branch reservoir, and adds:

Up to July 16 the natural flow of the Croton River was sufficient to supply the aqueduct to its full capacity, and from that date to Sept. 23 4,120,000,000 gallons of water were drawn from the storage reservoirs and lakes to keep up the maximum of supply. The phenomenal rainfall which occurred from Sept. 21 to Sept. 24 increased the flow of the streams so rapidly that on Sept. 24 water was running over the Croton dam at the depth of five feet, and the reservoirs and lakes which had been drawn upon were nearly replenished. There has been no interruption to the steady delivery of water through the aqueduct to its full capacity. The improvement and reenforcement of the weaker portions of the aqueduct were continued.

Favorable progress has been made on the works to secure an additional water supply from the Bronx and Byram Rivers. Work has been in progress on five contracts, including the construction of the reservoir at Kensico, and four sections of the conduit line thence to the city.

In extending the water service to new streets and districts 4 83-100 miles of pipes were laid; 225 water meters were set, making 6,600 meters in use on Sept. 30. The inspections of house drains at night time showed 148 places where water was being wasted and run into the sewers between the hours of midnight and 6 A. M., at the rate of from one-half to ten gallons per minute, showing that a large number of people persist in careless or wilful waste by leaving faucets open at night. The natural increase in legitimate and necessary consumption, arising from constant additions to our population, manufactures and commerce, is a sufficient strain upon the capacity of our present water supply, without the various elements of careless and wanton waste. The problem of suppressing this waste to such an extent as to enable the department to satisfy all actual needs until the time when we can receive an additional supply by a new aqueduct, from the superabundance available in the Croton basin, will tax all the ingenuity, vigilance and energy which can be applied to the subject. A large portion of the population is apparently indifferent to, or ignorant of, the perils which a continuance of waste will inevitably bring upon the community. Even at this date the pressure in the mains in some parts of the city is so reduced that the water does not run above the ground floor. A further loss of pressure at such places would result in most serious consequences. Complaints of inadequate pressure are as frequent, however, from the more favored parts of the city. People who have been accustomed to have the water running in closets and basins, and baths to the top floor consider themselves grievously wronged because they must now submit to the use of pumps or other expedients to obtain it above the second floor, and from the tenor of the complaints received it is evident that, notwithstanding the information which the department has endeavored to diffuse for years past, through its periodical and special reports, and by means of communications addressed to the people through the daily press, a great deal of ignorance still prevails in regard to the actual condition of the water supply. It seems impossible for some people to rid themselves of the idea that a large rainfall should be followed by an increased delivery of water in the city, whereas, in dry as well as in wet weather, throughout the year, we are receiving the full volume of water which the aqueduct is able to bear and convey to the city.

The results achieved by the use of water-meters, house inspections and inspections of house drains at night time, so far as the department has been enabled to apply these measures, are most satisfactory, and without the stoppage of waste which has been effected by these means, a great part of the city would now be in a most deplorable condition regarding the water supply. Further and more practical measures for the suppression of waste must be adopted, however, in order to maintain a fair distribution and supply of water to the constantly growing number of consumers during the years which must necessarily intervene before the completion of another aqueduct.

◆

THE *North American Review* for January opens with a symposium in which three of the most prominent advocates in this country of the "Revision of Church Creeds," namely, Rev. Dr. Newman Smyth, Rev. Henry Ward Beecher and Rev. Dr. Lyman Abbott, set forth the grounds upon which such revision is deemed necessary as a defense of revealed religion against the encroachments of skepticism, and as an adjustment of the relations between faith and science. "University Education for Women," a question that just now is being warmly agitated both here and in England, is discussed by Prof. W. Le Conte Stevens, who, though he zealously advocates the measure, commands the attention and respect of its opponents by the eminent fairness with which he states the adverse arguments. Prof. Isaac L. Rice gives a "Definition of Liberty," deduced from a profoundly philosophical study of the phases of political evolution, from the earliest Anglo-Saxon times to the present day. "American English," by Gilbert M. Tucker, is a spirited defense of our cis-Atlantic fashion of English speech against the aspersions of sundry British critics. The Rev. Dr. H. W. Thomas writes an article that can hardly fail to strike a sympathetic chord in many a mind, on "The Responsibilities of Progressive Thinkers." "Bigotry in the Medical Profession," by Dr. David Hunt, is a protest, from the pen of a respected member of the medical profession, against the First Commandment of medical ethics, which forbids association with any but regular practitioners. Finally, Charles T. Congdon, under the singularly apt title of "Adulteration of Intelligence," exposes some of the grave evils to be apprehended from the monopolization of telegraph lines, press associations and influential public journals. Published at 30 Lafayette Place, New York.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

THE Gas Commission of this city has decided upon the conditions on which it will grant a franchise to the Equitable Gas Company. The conditions will require the Equitable Company to construct their works in such a such a way as not to create a nuisance or be in any way detrimental to public health. The gas is to be of the best quality of illuminating gas, of not less than 25-candle power, and shall be free, within limits not injurious to the public health, from ammonia, sulphureted hydrogen, and other sulphur and noxious ingredients. The public lamps are to be lighted at a rate not to exceed $12 per lamp per year, each lamp consuming 3 feet of gas per hour, and burning 4,000 hours per year. This price is to include gas, lighting, extinguishing, cleaning, repairing and reglazing the lanterns. The company will be required to put in a bid for lighting public lamps at not over $12 per lamp whenever the Gas Commission issues a call for such proposals. If at any time during the continuance of the franchise the Commissioner of Public Works shall consider that the cost of manufacturing gas is reduced so that the lamps can be lighted for less than $12 each, arbiters shall be appointed to determine an equitable rate below $12. The company will be required to furnish gas to public buildings of the city at a rate not exceeding $1.50 per 1,000 cubic feet, and to the public at a rate not over $1.75 per 1,000 feet. Other provisions of the conditions require the company to lay gas mains in such streets as the Public Works Commissioner may direct, and to keep the pavements over the mains in good order for one year. Weekly and monthly reports are to be made to the Public Works Commissioner of the street openings made, gas mains laid, etc., by the company. The erection of the gas-works is to be commenced within six months from the date of signing the conditions, and not less than $250,000 shall be expended in the construction of the works before the company shall begin laying mains. The manufacture and distribution of gas shall begin within 18 months of the date of signing the conditions. The franchise is to be limited to 30 years, and it is to be revoked upon the failure of the company to comply with any of the conditions. The city is to be paid 20 cents for each lineal foot of main laid. The last section of the conditions prohibits the Equitable Gas Company from entering into any kind of combination with any other gas company.

THE Leavenworth (Kan.) water-works will be in operation about Jan. 1.

THE Northboro' (Mass.) water-works were put in use last Monday.

THE Peoria (Ill.) water-works committee has abandoned further work on the experimental well at the water-works, after having sunk it to a depth of 1,807 ft. 10 in.

THE artesian well at Hope, Arkansas, has been cased for over 400 ft., and boring will go on till an abundant supply of water is found.

ELECTRICITY.

EASTON, Pa., is practically lighted by electricity.

THE Edison Company has established a light and power station at Roselle, N. J.

THE Eau Claire (Wis.) Electric Light and Power Company has filed articles of association.

A PROJECT TO RUN STREET CARS BY ELECTRICITY.—The Chicago *Tribune* says that the West Division Street Railway Company is considering the idea of running its cars by electricity. Elmer A. Sperry, of Courtland, N. Y., a well-known electrician, is the projector of the system. It is understood that the system will run and light the cars besides, and light the track for a third of a mile ahead of the car.

STREETS, DRAINAGE, ETC.

THE Aldermen of this city have voted to forbid the proposed new street-cleaning contract.

RAILROADS.

THE ELEVATED ROADS TO PAY DAMAGES.—The Corporation Counsel of this city has advised the Mayor that the city has nothing whatever to do with the claims made against the New York Elevated Railroad Company by the owners of the property fronting upon streets in which the structures of the company are placed. If such owners recover judgments against the company on account of damages done to them or their property by the construction or operation of the railroad, the company will be compelled to pay the judgments, and, in his opinion, will have no recourse against the city. The city has no occasion, therefore, to intervene in the actions brought by these owners.

ON the 20th a petition of Hinton Rowan Helper was presented in the Senate relating to a railway between North and South America, asks the appointment of a commissioner at a salary of $10,000, and of an assistant at a salary of $3,000 per annum, to obtain information concerning the expediency of constructing a railway to connect "the three Americas."

A DISPATCH from Galveston, Texas, states that work on the International railway extension has been permanently suspended. It seems that the Gould-De Gress concession from the Mexican government contains a provision which absolutely forfeits to Mexico all work done in the event that the road should fail to be completed in conformity with the charter at the terms therein specified; and provides further that the Mexican government shall be the supreme arbiter of the matter, should a forfeiture occur.

ELEVATED RAILROAD PROFITS AND EXPENSES.—The following railroad companies have reported to the State Engineer of this State for the year ending Sept. 30: The Manhattan Railway Company.—Passenger earnings, $5,922,688.12; total earnings, $5,978,638.41; total charges against earnings, $5,657,501.62. The New York, Woodhaven & Rockaway Company.—Passenger earnings; $122,470.64; total earnings, $143,403.44; total charges against earnings, $184,413.50. The Brooklyn, Bath & Coney Island Railway Company. Passenger earnings, $12,258.02; total earnings, $49,358.57; total charges against earnings, $15,566.74. The New York, West Shore & Buffalo Railroad Company reports its capital stock and installment account as $12,708,400; funded debt, $19,528,000; unfunded debt, $327.50; cost of road and equipment, $33,209,553.75; cash on hand $150.38; land accounts in process of adjustment, $20,029.37.

THE two Trans-Caucasian lines of railway from Tiflis to Baku, Russia, on the Caspian, and from the Tiflis-Poti line to Batoum on the Black Sea, are completed, and will be opened for traffic on the 1st of January next.

RAILROAD BUILDING is being carried on to a stupendous extent. It costs about $25,000 per mile and yet fully 10,000 miles will be added to the facilities of the United States during the year 1882. This is exclusive of a considerable addition of lines in Canada and Mexico, in which American capital is interested. Some of the road is double track, and most of it laid with steel rails. The outlay for this single form of internal transportation improvement reaches annually about $250,000,000.

A NEW ROAD.—The St. Louis and Chicago Railroad company filed articles of incorporation in the office of the secretary of state of Illinois. The line is to begin at East St. Louis, in the county of St. Clair, Ill., running in a northerly direction through the counties of St. Clair, Madison, Macoupin, Montgomery, Sangamon, Logan, Dewitt, and McLean, Ill., Its termination will be near the city of Bloomington. Its principal offices are to be in the city of Litchfield. The capital stock is $3,000,000.

A CANADIAN RAILWAY SOLD.—WINNIPEG, Manitoba, Dec. 17.—Negotiations with reference to the transferring of the stock of the Portage, Westbourne and North-western Railway from the hands of the directors originally authorized to construct the line to the control of a syndicate, of which the late Sir Hugh Allan was a leading member, has been concluded. The price paid for the road was $615,000, of which $365,000 was in cash. The road is in running order as far as Gladstone, and the grading is completed 15 miles beyond. A section will be railed and ready for traffic by the 1st of April. Tenders for construction as far as Minnedosa will be let immediately.

ALBANY, Dec. 15.—The New York, Richfield Springs and Cooperstown Railway Company, with a capital of $6,000,000, was incorporated to-day.

THE THIRTY-EIGHTH ANNUAL REPORT of the State Board of Railroad Commissioners of New Hampshire has been published. No new roads for steam cars have been built during the year, but the extension of the Bethlehem Branch of the Profile & Franconia Notch railroad from the Junction to Bethlehem has been completed.

Contracts have been executed which will result in the speedy construction of the Pemigewasset Valley railroad from Plymouth to North Woodstock. The Legislature of 1881 granted charters for horse railroads in Dover and Laconia which have been finished and put in operation. The act of the Legislature requiring all railroad corporations to erect and maintain suitable guards, or "tell-tales," at every bridge or other structure, any portion of which crosses the line less than eighteen feet above the track, has been complied with by every railroad in the State. As is well-known, the above law was intended to secure the protection of such employés as are required at times, in the discharge of their duties, to walk on the top of moving trains. There are thirty-four steam railroads with a total extent within the limits of the State of 1008.09 miles. The Manchester Horse Railroad has a length of 2.50 miles and the Concord Horse Railroad 3 85 miles. The statistical reports prove that nearly all of the lines are able to show a gratifying increase in their earnings over the preceding year, which has enabled the managers to put the road-beds in better conditions, add to their equipment and generally improve their condition.

ARTICLES OF INCORPORATION of the Indiana Pacific Railroad have been filed with the Secretary of State of Indiana. The proposed road begins at Auburn, and runs directly west to Bourbon, thence to North Judson, Ind., where it makes direct western connections.

CHICAGO & ATLANTIC.—The last rail connecting the two ends of the Chicago & Atlantic Railroad was laid recently between Huntington and Rochester, Ind.

RAILWAY CONSTRUCTION IN RUSSIA.—The Cologne *Gazette* publishes a letter enumerating eight railways urgent constructed on the western frontier of Russia, whic prb far as can be seen, are not required for commerc[illegible]hc ii-poses.

THREATENED RAILROAD LITIGATION, Boston, Dec. 21.—Serious legal difficulties are threatened between the Boston, Hoosac Tunnel & Western Railroad and the Continental Construction Company, which contracted with the late Gen. Burt to complete the road from the Hudson River to Buffalo. The construction company, it is said, is seeking to control the policy of the railroad, while its charter does not authorize it to own stock in it. The first manifestation of the trouble has been in the refusal of the auditor and assistant treasurer to deliver his books to a successor appointed by General Manager Morrill of the Boston, Hoosac Tunnel & Western. The matter is likely to get into courts in Massachusetts and New York.

FINANCIAL.

THE City Council of Winnipeg has received an offer from Edinburgh of 99¼ for $500,000 of debentures, and a month is asked in which to take the remaining $500,000 at par.

AGAINST THE SIEMENS-ANDERSON COMPANY.—A judgment for $309,875 in favor of the Merchants' and Manufacturers' Bank of Pittsburgh against the Siemens-Anderson Steel Company was filed Thursday, that being the amount of note with interest and cost of action.

CONTRACTS LET.

BRIDGE CONTRACT LET.—The Missouri Valley Bridge & Iron Works, Leavenworth, Kansas, has been awarded the contract for building three 140-ft. iron span across the Mississippi at St. Paul, Minn., for $29,300. Also, ten 100-ft. iron spans over the Arkansas River, at Wichita, Kansas, for $35,000. This is the first iron bridge over the Arkansas.

CANALS.

LAUNCH OF A DREDGE FOR THE PANAMA CANAL.—PHILADELPHIA, Dec. 21.—Dredge No. 1, built for use on the Panama Canal, was successfully launched here to-day. It is called the Count de Lesseps, and is said to be the largest dredge ever built.

BUILDING.

CHICAGO'S BOARD OF TRADE BUILDING.—The new board of trade building will be 170 ft. 9 in. by 160 ft. in depth. The tower in the center, facing La Salle street, will be 32 ft. wide and will rise 240 ft. This tower is to be capped by a pinnacle 40 ft. in height, and will be surmounted by a statue of Mercury. The two corners on La Salle street will be topped with pavilions 22 ft. square. There will be a tablet 56 ft. long by 28 high on each side of the main building. The tablets will be crowned by statues of Ceres, 18 ft. high. On the two southern corners will be double towers raised slightly above the roof. The entire architecture will be Gothic. The main hall will be 13 ft. above the sidewalk, its dimensions being 155x100 ft., and it will have two galleries. Above the second floor will be six stories for offices. The total floor room will comprise 23,000 square feet. South of the main building will be another structure for offices, 170x65 ft. in dimensions, and nine stories high. The entire edifice will be fireproof.

LABOR.

THE Phœnix Iron Company of Phœnixville, Pa., employing 3,000 men, have posted notices in their works informing the employés that a reduction of wages will go into effect Jan. 1 next, puddlers to receive $4 per ton and other employés to be reduced about 7 per cent.

OBEYING THE SUNDAY LAW.—A note from Troy, N. Y., says: "The mills of the extensive Albany and Rensselaer Iron and Steel Company were shut down yesterday, the 17th. It is announced that there will be no more Sunday work hereafter in the mills of that company. The steel works will shut down on Sunday morning and resume work on Monday night.

BRIDGES.

A COMPANY has been formed among business men of Omaha and Council Bluffs to build an immense wagon and foot bridge across the Missouri, resting on iron piers, according to the plan of the Union Pacific bridge. The capital to be subscribed is $2,000,000. Bills have been introduced into the Senate and House in Washington for a license to build and operate.

BRIDGING THE ST. LAWRENCE.—The Montreal *Witness* states that it is understood that Mr. C. M. Armstrong, of the Great Eastern Railway, who is at present in Europe placing the bonds of the Great Eastern on the London market, has met with considerable success. In the meantime the company, through its solicitors, Messrs. Ker & Carter, has given notice that it will apply at the next session of the Dominion House to amend its charter by providing that the capital of the company shall be $6,000,000, and that it shall be authorized to build a bridge across the River St. Lawrence near Montreal

MISCELLANEOUS.

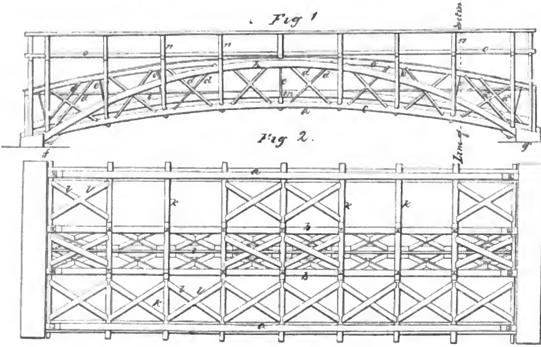
ORE PRODUCTIONS.—Leadville, during the past five years, has produced 48,000,000 ounces of silver, 140,000 tons of lead, and 26,000 ounces of gold, exclusive of 100,000 tons of ore shipped to other towns for treatment. It will pay this year to the railroad companies $1,000,000 for the transportation of bullion to the eastern markets.

TRUSS BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

Nov. 4, 1846, Lowman Gay, of New York, patented a truss bridge. Fig. 1 is an elevation, Fig. 2 a plan, anp Fig. 3 a vertical section through the dotted line in Fig. 1.



GAY'S BRIDGE.

a a are the two outside arch trusses, and *b b* the inside ones. The trusses *a a* are composed of a bottom and top arch piece *c c'* of different curvatures. The arch and chord are connected by means of rods *e*. The diagonal braces *d d'* extend from the top to the bottom arch piece, and are mortised into them at a distance from the rods equal to about one-sixth of the width of each section, so that the rods at their juncture with the arch pieces become fulcra for the arch pieces to transfer the strain brace to the next without the series. The inside trusses *b b*, incline toward each other at an angle of 70° and meet at the top. The outside arches may be further stiffened by an arch *n* of a smaller curvature than the arch *c c'*, so as to be connected at the abutments to the lower arch piece *c*. A tension rod *i* connects the upper arch and runs along horizontally between the two inclined arches.

The sleepers *k* are braced by diagonal braces *l l* to resist horizontal strain. Over the sleepers are placed other arch pieces *m*, over which also are placed fonr series of post *n*. The tops of these posts sustain the top rafters *o*, on which may be placed the rails *p p* of a railroad, a canal *g*, or a roof. It is further supported by vertical posts *s*, which rest on the top of the middle inclined arches. *t t* are the roadways between the two outside and the middle trusses.

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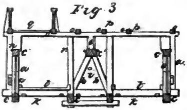
* Copyright, 1882.

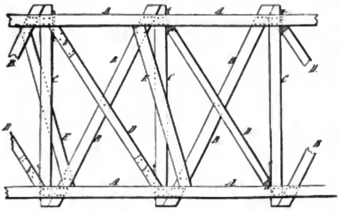


Gay's Bridge.

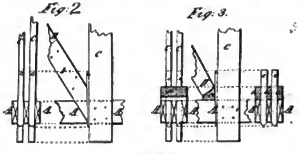
Nov. 13, 1847, Stephen H. Long, U. S. Topographical Engineer, devised a bridge in which *A* are the chords composed of two or more pieces with splicings. *B* are the main suspension braces, each consisting of one or more pieces. *C* are the posts having the same number of pieces as the main suspension braces. *D* are the main thrust braces; *a* the braces bolsters; *b* the brace "gluts;" *c* the brace keys; *d* the arch brace bolsters; and *e* bridge bolsters. *E* are the extra braces.

The main suspension braces are so arranged in their connection with the other parts of the truss frame that they act both by *tension* and by *thrust*, or by either according to the stresses to which the bridge is subjected. They may be rendered contractile by introducing splicing pieces, gibs keys, etc., after the manner observed in the application of these parts to the splicings of the inferior arch braces. The parts of which each main thrust brace is composed are clamped by means of trenails, and blocks or "gluts" intervening between the parts, in such manner as to keep them in their appropriate relative positions. The number of brace pieces in each panel is the same as the number of string pieces in each chord, instead of being the same as the number of spaces between the string pieces; moreover, instead of being closely connected to the posts, their extremities are rendered movable along the strings or chords, by means of bolsters or gluts and keys, whereby the trussing of the bridge if effected in a manner different from any construction heretofore. The main thrust braces may be inserted or withdrawn from the truss frame at pleasure.

Fig. 1.



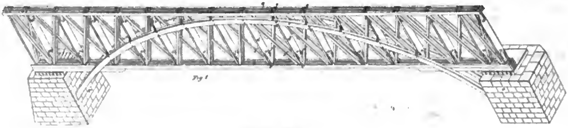
Long's Bridge.



Long's Bridge.

Feb. 20, 1849, J. Dutton Steele, of Pennsylvania, received a patent for a truss bridge. Steele connected the arches to the posts alone, and the posts were so connected with the chords as to admit of the changing of the position of the arches relatively to the chords. The chords were drawn together to camber the truss without changing the position of the arches. *a b* are the upper and lower chords connected by posts *d*, the ends of which are let into recesses formed in a series of bevel-faced "skewbacks" *e e*.

Each post has four screw rods *g* which pass through the skewbacks and chords, and are provided with screw-nuts *h* so that by the turning of these nuts the posts can be either raised or lowered or the chords drawn together.

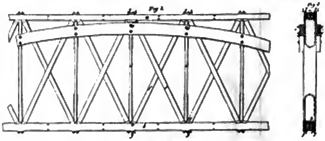


Steele's Bridge.

The arch pieces *i i* are secured by bolts *j j* to the outer faces of the posts alone, and their extremities made to rest against the piers.

In screwing up the truss care is taken that the posts do not come in contact with the chords.

In time, should the weight be thrown upon the arches making them bear ultimately an undue portion of the load, the camber must be restored and the posts moved up so as to again divide the strain between the arches and trusses. This adjustment, the inventor says, must take place once or twice in each year, until the timber is perfectly seasoned, after which but little attention will be required.



Steele's Bridge.

(TO BE CONTINUED.)

CORRESPONDENCE.

CONCERNING RIVETING.

Tokio, Japan, Nov. 16, 1882.

Editor Engineering News:

If you will kindly allow me a little space in your paper, I would like to call attention to something which is greatly needed not only by students of engineering and young engineers, but also by many who have served for years in the profession—an exhaustive treatise upon riveting.

I have already referred incidentally to this matter in a paper on "A System of Designing Highway Bridges," which you saw fit to copy in your issue of March 25, 1882, and I would now urge upon some member of the profession, who has had considerable experience in this line of work, to undertake the task and confer a great favor upon all those who are not so well posted on the subject as himself.

To such a one I would make the following suggestions, and offer a very incomplete list of headings or topics, together with a few tables which I have prepared for my own use.

First, to write to all the principal bridge companies and iron works where riveting is done, and request of them their rules and all the information upon the subject which they would be willing to give, in order to obtain the practice of as many experts as possible. It is by no means certain that much information would be obtained in this way, for bridge companies seem to be somewhat chary about giving for nothing what has cost them both time and money to find out for themselves. This does not show a very good professional spirit; besides, it is a mistake to suppose that they would lose by giving information gratis, for it would improve the business of every first-class bridge company, if the standard of excellence in bridge construction were higher.

In regard to this conservative spirit I can speak from experience, for, having intended to work up the subject of "Dead Load in Bridges," and to ascertain, if possible, the effect of the different factors producing the dead load, reducing the same to some approximate laws, I sent around some blanks to the principal bridge companies to be filled out with the data required. The result was a lamentable failure; not a single blank was returned.

TABLE I.

Table of Working Shearing Stresses in Tons of 2,000 Pounds upon Rivets for Railroad and Highway Bridge.

Diameter.	Railroad.	Highway	Diameter.	Railroad.	Highway
½″	0.59	0.74	⅞″	1.80	2.25
⅝″	0.92	1.15	1″	2.36	2.95
¾″	1.33	1.66	1⅛″	2.98	3.73

TABLE II.

Table of Working Bending Moments in Inch-Tons on Rivets for Railroad and Highway Bridges.

Diameter.	Railroad.	Highway	Diameter.	Railroad.	Highway
½″	0.092	0.115	⅞″	0.493	0.616
⅝″	0.180	0.225	1″	0.736	0.920
¾″	0.311	0.389	1⅛″	1.038	1.298

TABLE III.

Table of Working Bearing Stresses of Rivets on Plates in Railroad Bridges.

Diameter.	$\frac{3}{16}$″	¼″	$\frac{5}{16}$″	⅜″	$\frac{7}{16}$″	½″	$\frac{9}{16}$″	⅝″	$\frac{11}{16}$″	¾″	$\frac{13}{16}$″	⅞″	$\frac{15}{16}$″	1″	1$\frac{1}{16}$″	1⅛″	1$\frac{3}{16}$″	1¼″
½″	0.563	0.750	0.938	1.125	1.313	1.500	1.688	1.875										
⅝″	0.703	0.938	1.172	1.406	1.641	1.875	2.110	2.344	2.578	2.813								
¾″	0.844	1.125	1.407	1.688	1.969	2.250	2.532	2.813	3.094	3.375	3.656	3.938						
⅞″	0.984	1.312	1.641	1.969	2.297	2.625	2.952	3.281	3.609	3.938	4.266	4.594	4.922	5.250				
1″	1.125	1.500	1.875	2.250	2.625	3.000	3.376	3.750	4.125	4.500	4.875	5.250	5.625	6.000	6.375	6.750		
1⅛″	1.266	1.687	2.110	2.531	2.953	3.375	3.797	4.219	4.641	5.063	5.485	5.906	6.328	6.750	7.172	7.594	8.016	8.438

TABLE IV.

Table of Working Bearing Stresses of Rivets on Plates in Highway Bridges.

Diameter.	$\frac{3}{16}$″	¼″	$\frac{5}{16}$″	⅜″	$\frac{7}{16}$″	½″	$\frac{9}{16}$″	⅝″	$\frac{11}{16}$″	¾″	$\frac{13}{16}$″	⅞″	$\frac{15}{16}$″	1″	1$\frac{1}{16}$″	1⅛″	1$\frac{3}{16}$″	1¼″
½″	0.704	0.938	1.172	1.406	1.641	1.875	2.110	2.344										
⅝″	0.879	1.172	1.465	1.758	2.051	2.344	2.638	2.930	3.223	3.516								
¾″	1.055	1.406	1.759	2.110	2.461	2.813	3.165	3.516	3.868	4.219	4.570	4.923						
⅞″	1.230	1.640	2.051	2.461	2.871	3.281	3.691	4.101	4.511	4.921	5.331	5.742	6.153	6.562				
1″	1.406	1.875	2.344	2.813	3.281	3.750	4.220	4.688	5.156	5.625	7.094	6.563	7.031	7.500	7.969	8.438		
1⅛″	1.583	2.109	2.638	3.164	3.691	4.219	4.748	5.274	5.801	6.328	6.856	7.383	7.910	8.438	8.965	9.493	10.020	10.548

N. B. The working stresses per square inch are as follows:

	Shearing.	Bearing.	Bending.
Railroad bridges	3.00 tons	7.500 tons	6.000 tons
Highway bridges	3.75 "	9.375 "	7.500 "

Second, to collect all that has ever been written upon the subject both directly and incidentally.

Finally, to combine the information thus obtained with the writer's personal experience, and make the treatment of the subject complete in every particular.

The topics referred to are these: spacing of rivets of different diameters, sizes of rivets for different thicknesses of plate, minimum distances from edges of rivet holes to edges of plates, same for angle irons, I beam flanges, T flanges, channel flanges, etc., sizes and weights of heads required for different rivets and the corresponding lengths, table of minimum spacings of rivet holes where there are several rows of staggered rivets, thus:

Dia.	1″	1⅛″	1¼″	1⅜″
½″	....	....	....	....
⅝″	....	....	....	....
¾″	....	....	....	....
Etc.	....	....	....	....

Rivet spacing in top chords, in splice and reinforcing plates, in lacing and latticing, in floor beams with parallel and inclined flanges, in tension joints, in boilers, etc.; hand riveting, machine riveting, comparison of the two, riveting tools, riveting machinery, method of preparing working drawings with a view to rapidity and ease in punching, countersinking and depth required for same for different diameters of rivets, field riveting, number of rivets that can be driven per day per man in shop and in field, number that can be driven by a machine, cost of the different kinds of riveting, criticism of Weyrauch's treatment of the subject in his work on "Structure of Iron and Steel," the uncertainty as to what portion of the total stress each rivet of a group takes up, effect of friction in reducing stresses upon rivets, wear and tear of rivets, comparison of pin connected and riveted girders, manner in which riveting may fail, etc.

Rivets, especially in bridge work, are usually figured for shear, but would they not give by bending rather than shearing, or is there some circumstance that would reduce the calculated bending moments?

As to whether the writer of such a paper as the one indicated would be repaid for his labor—pecuniarily, no; for technical papers seldom bring in enough profit to the authors to pay for even the time spent in writing—but indirectly, yes; in many respects.

In regard to publishing there would be no difficulty, for any of the engineering societies or periodicals would be glad to publish such a useful article.

I should be very happy to correspond with any one undertaking tha paper, especially if I could be of any assistance. Yours very truly,

J. A. L. Waddell,
Professor of Civil Engineering in the University of Tokio, Japan.

QUESTION IN PATENT LAW.

Dec. 21, 1882.

Editor Engineering News:

If a patent be issued on an article can that article be manufactured or made by a person for his own private use? Can it be made by a person for the use of his assistants in his own office? And can he employ an assistant to make the article for his own use and for that of other assistants in his own office, with no intention of selling or giving away the article without legally infringing on said patent? I.

[We have been informed that a patented article can be manufactured for individual use without its being an infringement. We do not know it for certain.—Ed. Eng. News].

ENGINEERS' BOOK OF TABLES.

New Haven, Conn., Dec. 25, 1882.

Editor Engineering News:

Will you please send me six copies of the West Shore tables. Enclosed find six dollars for same.

Yours truly, John V. B. Clarkson,
Room 57, 69 Church street, New Haven.

[Thie is Mr. Clarkson's second order.]

SHIP BUILDING—CORRECTION.

Editor Engineering News:

Ferrysburg, Mich., Dec. 19, 1882.

In about the middle of the second paragraph of the middle column of page 427 you have, "Then is *B C* the actual working pitch corresponding to the width of the blade." It should be, "Then is *B G* the actual, etc."

Also, at the close of the paragraph your printer has given us "*B C*, too, has been called the full slip." It should be, "*D C*, too, has, etc.

In the first formula, same column, the printer has given us *main* pitch for *mean* pitch.

These are small things, but they turn into *chaff* the one small grain of wheat I had worked so long to bring out. H. C. Pearsons.

BAD TASTE IN WATER.

Lee, Mass., Dec. 22, 1882.

Editor Engineering News:

Sir: Please advise through the News, as to this:

After water has been turned off the street mains of our water service, when first turned on again it invariably runs white and milky, lasting for a day or so. After standing a few minutes it begins to clear itself from the bottom, having a sort of scum or froth on top.

We use cement-lined pipe; have 200 ft. head; pipes been in use a year. I give these details so that you may fully understand the situation.

An answer will greatly oblige

A Subscriber.

BRIDGE SEATS.

Chillicothe, O., Dec. 20, 1882.

Editor Engineering News:

What is the rule or practice followed in determining the amount of seat to be given railway and highway bridges, of iron or wood, on the stone abutments and piers? C. B. C.

STEEL RAILS.

Editor Engineering News:

Detroit, Dec. 26, 1882.

Can you tell me when steel rails were first brought into New York, where from, what price, and the duty paid? C. Hurlbut.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(Continued from page 437.)

CCCCXLVI.—CHATTANOOGA.

Chattanooga, Tennessee, in lat. 35° 3′ N. long. 85° 10′ W., is on limestone hills rising to 300 feet above the Tennessee River.

Settled in 1840, it was incorporated in 1850.

Water-works were begun by the U. S. army in 1864, were purchased by a private company which, after operating them a short time, failed, and they were bought by the Lookout Water Company, the present owners.

The supply is taken from the Tennessee River and pumped 175 ft. to a reservoir on the hill, 125 ft. above the business part of the city. It is in two compartments, respectively 135 and 160 ft. long and 150 ft. wide and 12 ft. deep, lined with brick on puddle. They are filled and emptied alternately to allow for settling the water. Pumping is by steam. The first pump was a "Woodward" of 18 in. steam and 9 in. water cylinder. In 1871 a duplex pump of same kind and size was added, in 1877 another duplex of 20 in. steam and 12 in. water cylinders, and in 1881 a Worthington or "Worthington" of 20 in. steam and 14 in. water cylinders of 30 in. stroke.

Distribution is by 15 miles of cast-iron pipe of from 12 to 4 in. diameter, with 58 fire hydrants, 55 gates and about 1,000 taps. The city pays $50 per year for each hydrant and also the municipal taxes on the company's property. Service pipes are of wrought-iron. There are no meters in use, as they have not proved available with the muddy water. For distribution one half mile of Wyckoff pipe was laid for trial, but has been removed.

The population in 1880 was 12,892. The daily average consumption is 1,000,000 gallons.

The capital stock of the company is $50,000. The works have cost $130,000. The bonded debt is $80,000 at 7 per cent. interest. No further financial statements are furnished.

A. M. Johnson is President and manager.

CCCCXLVII.—MEDIA, PA.

Media, Pennsylvania, in lat. 39° 55′ N., long. 75° 15′ W., is on rolling ground on Ridley Creek, 5 miles from the Delaware River.

It was settled and incorporated as a borough in 1850.

Water-works were built by the borough in 1870, after plans of Isaac F. Cassin, C. E., taking the supply from Ridley Creek, which has a water-shed of 12 square miles. A dam of rubble masonry, 150 ft. long and 10 ft. high, impounds the water and furnishes head to drive a turbine-wheel which works a pump of 300,000 gallons per day capacity. A Worthington duplex steam-pump of 500,000 gallons capacity was added in 1875. The water is pumped 274½ ft. to a reservoir of 1,500,000 gallons capacity, built in excavation and embankment, from 52 to 142 ft. above the town.

Distribution is by 6½ miles of cast-iron pipe, of from 12 to 4 in. diameter, with 25 fire hydrants, 36 gates and 385 taps.

The population in 1880 was 2,019. The daily consumption is 125,000 gallons.

The population is largely increased in summer by boarders and summer residents.

The works cost $65,000, which is the amount of the bonded debt at 4 per cent. interest. The expenses in 1881 was $1,200 and the receipts $4,028.

The works are managed by the Water Committee of the Borough Council. William Mancll is the Superintendent. Charles R. Williamson is Chairman of the Water Committee.

CCCCXLVIII.—ARLINGTON, MASS.

Arlington, Massachusetts, in lat. 42° 24′ 56″ N., long. 71° 9′ 34″ W., is on broken ground at the head of Mystic River.

Settled about 1735 it was incorporated as West Cambridge in 1807, and its name was changed in 1867.

Water-works were built by the town in 1872, after plans of W. A. Mason and C. D. Elliot, C. E., taking the supply from Lexington Great Meadows and North Brook, with a water-shed of 4½ square miles.

An earth dam with puddle heart, built across the valley at the mouth of North Brook forms a storage and distributing reservoir of 31 acres area and 10 ft. deep, holding 77,000,000 gallons at 117 ft. above the center of the town. The supply pipe to the town is of 12 in. wrought iron cement lined pipe. Distribution is by 14 miles of pipe from 12 to 4 in. diameter. That first laid was of cement-lined wrought-iron. Cast-iron is used for all extensions. There are 98 fire hydrants, 79 gates and 480 taps. The town contributes $1,000 per year for fire protection. Service pipes are of wrought-iron, cement-lined.

The bed of the reservoir was a peat meadow, and in 1876 the surface water in the reservoir was of unpleasant taste and odor, and a filter gallery was built near the reservoir, in porous ground, 135 ft. long, 12 ft. wide, with vertical side walls of stone, 4 ft. high, and arched over with brick. The bottom was 12 ft. below the surface of the ground. From one end a semicircular brick arch of 20 in. span, on timber flooring, extended 600 ft. From the end of this a 12-in. cast-iron pipe was laid to the supply pipe from the reservoir. In 1877 another gallery was built parallel to the first and inside the reservoir, being a brick culvert of 4 ft. span, each end of which was connected with the first gallery by drain pipe laid with open joints.

In 1880 the gallery was extended 100 ft. The soil is not very favorable for infiltration, and the yield is small.

In 1877 a brick conduit, 3 ft. in diameter, was built to divert water from the great meadows and Brown's brook to the reservoir.

The population in 1880 was 4,100. The daily consumption is not known.

The works had cost to Dec. 31, 1881, $438,636.59, and the receipts had been $85,610.43. The bonded debt is $300,000, at 5 and 6 per cent. interest.

The expenses in 1881 were $1,130.83, and the receipts $9,568.78.

The works are managed by three elected commissioners. Sylvester Stickney is the Superintendent.

CCCCXLIX.—SALEM, O.

Salem, Columbiana County, Ohio, is in lat. 40° 57′ N., long. 81° 55′ W.

Water-works were built as a private enterprise in 1862 by A. Philips, taking the supply from a spring and pumping it 45 ft. by a single-acting plunger pump of 6-in. bore and 12-in. stroke into a wooden tank holding 39,000 gallons, on a brick tower. In 1881 an artesian well was bored, and in May, 1882, a Worthington steam pump of 5¾ water and 6-in. steam cylinder was erected.

Distribution is by 4 miles of cast-iron pipe of 5 and 8 in. diameter, with 275 taps. There were some fire hydrants at one time, for which the town paid $500 per year, but now the supply for fire purposes is taken from cisterns for which the town pays $275 per year. Service pipes are of galvanized iron.

The consumption is not known. No financial statements are given. The works are now owned and operated by E. W. Silver.

CCCCL.—FROSTBURGH, MD.

Frostburgh, Maryland, in lat. 39° 40′ N., long. 78° 50′ W., is on a plateau between Savage and Dan's mountains, 1,792 ft. above sea level.

Water-works were built in 1855 by a private company, taking the supply from springs on the slope of Savage Mountain, 1 mile from the town. The water was conveyed from the springs to a stone reservoir 50 ft. square and 10 ft. deep, by 4-in. cast-iron pipes. In 1868 these pipes had become filled with rust, and were replaced by 6-in. pipes. There is a large wooden tank on the mountain side which affords sufficient head and storage for fire extinguishing without the use of fire engines.

Distribution is by 3½ miles of cast-iron pipe of 8 to 4 in. diameter. In 1874 the 4-in. pipe originally laid in the main streets were found insufficient, and were replaced by larger sizes. There are 20 fire hydrants, 15 gates and 180 taps.

The daily consumption is 23,000 gallons.

The first works cost $10,000. The expenses in 1882 were $350, and the receipts $1,700

William O. Sprigg is the manager.

TO BE CONTINUED.

The receipt of statistics as follows is acknowledged with thanks: From Isaac S. Cassin, C. E., statistics of Media, Pa., water-works. From E. W. Silver, proprietor, statistics of Salem, Ohio, water-works. From Robert Weir, Water Commissioner, history of Cohoes, N. Y., water-works. From George I. Wilber, Vice-President, statistics and water rates of Oneonta, N. Y., water-works. From F. W. Hodgson, Asst. Eng. Harbor and Land Commissioners, Boston, statistics of Arlington, Mass., water-works and reports 1874 to 1881. From W. O. Sprigg, Superintendent, statistics of Frostburgh, Md., water-works. From Luther Hill, President, statistics of Spencer, Mass., water-works. From Robert Surtees, City Engineer of Ottawa, statistics of water-works of Peterborough, Ont. From E. Mather, statistics of water-works of Decorah, Iowa, and report. From John C. Chase, Supt. and Engr. Clarendon Water-works Co., statistics and water rates of water-works of Wilmington, N. C.

TO WATER-WORKS OFFICIALS.

With the close of this volume of Engineering News "The History and Statistics of American Water-works," which has been in course of publication in our columns weekly since March 1881, comprises historical sketches and the fullest information attainable of the water-works of 450 cities and towns. No such collection of statistics of water supply has ever been made anywhere before. But the work is still incomplete. There are three hundred more towns in the United States and Canada which have public water supplies. Every one of them has been applied to, two, three and four times, to furnish the desired information. From some it has been promised, but from many no response has yet been had. *The information must and will be obtained*, and somebody or other will be persistently urged for it, until a response is obtained. One of the best descriptions recently procured, was accompanied by a note from the president of the Water Company saying, "your persistency has overcome my obstinacy," and so it will be in other cases. The work is of too much value to be abandoned half way, and we are sure that too much interest is felt in it by the great majority of the persons who manage and build water-works, to permit it to be stopped. The author of the work and the editor of this paper are in almost daily receipts of letters of inquiry regarding the completion of the work, and speaking of it in terms of high appreciation.

To satisfy, as far as practicable at present, the desire for some comprehensive and practically useful statement of the results already obtained Mr. Croes is now preparing and we will issue about Jan. 31 a table of the principal statistics of all the water-works from which replies have been received. This will be in pamphlet form and will be given away to all our subscribers and to the officers of the works. The issue of the completed book, "The History and Statistics of American Water-Works," we hope to be able to announce some time during the year 1883. To effect this we must have the co-operation of all who are interested in the subject. The author must be furnished with the data required, from the towns which have not responded. Of the 65 cities of over 30,000 inhabitants only Reading, Pa., and Mobile, Ala., have made no reply. The Controller of Reading has kindly sent financial statements, but four separate appeals to the officers of the water-works and two letters to private individuals who promised to give assistance have been unable to get a single figure. Is it possible that the Reading authorities know nothing about the history and condition of their own works?

Then of the 100 next largest cities in the country only Bridgeport, Conn., San Antonio, Texas, Haverhill, Mass., Norwalk, Conn., and Brockton, Mass., neglect to answer. The list can be extended to smaller towns, but it is hardly worth while to do so here and now. We propose to get the information anyhow, and if our friends will help us it will save trouble and facilitate the completion of Mr. Croes' invaluable book.

The organization of the Pittsburg, Akron & Chicago railroad has been perfected. The proposed road is to run west from Youngstown through Akron to the west line of Media County, intersecting with the Cleveland, Delphos and St. Louis Railroad. It is now proposed to build, equip and have in running order this seventy miles of road by January, 1884.

FOREIGN NOTES.

AN UNDERGROUND ELECTRIC RAILWAY.

The first electric railway in a mine is that in the Royal Saxon collieries near Zauckerode. It has just been opened, and is said to work excellently. The electric mine railway serves for transporting coal in a transverse heading of the 250-meter level. The locomotive, only 2 ft. 7 in. broad, weighs, according to *Glaser's Annalen*, 1,500 kilogrammes (about 1½ tons), and moves ten trucks weighing, loaded, 10 tons each at a rate of 10 ft. per second. The transmission of power is not effected by a center rail, but by a small contact carriage provided with brushes, running upon T-shaped iron rails, which is fixed, isolated, to the roof of the heading. The railway is at work from 4 a. m. to 11 p. m. Judging by the experiences of the Paris electric railways, it may be advisable to let the contact carriage run along a pipe instead of rails, to prevent its derailment. We hear that the Berlin West-end Electric Railway is being reconstructed on this principle.

IMPORTANT INVENTION IN THE METAL TRADE.

An invention which it is believed will effect important changes in the metal, and not only in this country but throughout the world, has been made by a Birmingham metal manufacturer, after thirty years of constant experiments, in which he has expended over 30,000*l*. The invention has just been patented in Great Britain, France, Germany, Russia, Austria, Belgium, Sweden, Italy, Spain, the United States, Canada, and India. It consists of a new process of making alumina, from which aluminum can be manufactured at about one-tenth the cost by ordinary methods; and as aluminum is recognized as the most valuable metal for forming workable alloys, the importance of the discovery cannot be overestimated. This, indeed is shown by the fact that companies in France have just offered upwards of a quarter of a million sterling for the patent right for that country alone, while the aggregate offers of American, German, Belgian and other companies amount to more than a million of pounds. The inventor is Mr. James Webster, of Hollywood, who has organized a company under the style of the Aluminum Crown Metal Works Company (Limited), seven proprietors to work the patent. Under the ordinary process alumina costs 1,000*l* a ton, whereas by Mr. Webster's process it is less than 100*l*, besides which all the bye products are utilised, and from these a blue dye is made, which, it is believed, will supersede indigo for calico printing, inasmuch as it permanently retains its color, and is not affected by acids. Mr. Webster's alumina deposit is certified by an eminent analyst to contain 81 per cent. of pure alumina as compared with 65 per cent. realized by the ordinary process, and the oxide can now be made in any quantity in the course of a few days, while hitherto it could only be produced in limited quantities, and the process required nearly nine months. At present, Mr. Webster is the sole maker of alumina in England, prior attempts to introduce the manufacture into this country having involved the promoters in immense losses, which compelled them to abandon it, and consequently the French have had the entire monopoly of the trade. Owing, however, to the expense of production, and the limited quantities of the metal produced, aluminum has hitherto only been used for small ornaments of jewelry, musical and mathematical instruments, the castings of machinery, etc., but it can now be used in combination with other metals for multitudinous purposes. Many tons of bismuth-bronze, manufactured for the aluminum, have been sent to Hull for conversion into steam propellers for the Eastern Steamship Company, the advantage claimed for the bronze being that it has nearly one hundred more resisting power than any other material used for the purpose, while in the event of a collision it will bend rather than break, and further, it will not corrode from the action of the salt water. It is also used for ship fittings, and is rolled into sheets for all kinds of purposes for which electro-plating is now applied, spoons, knives and forks, dish covers, railway carriage and tool handles, and other articles being made from it by a leading Sheffield firm. Aluminum bronze is also made which is adapted for the manufacture of artillery, and several consignments have been made to the Royal Gun Factory at Woolwich by order of the War Office. The metal has a straining power of 42 tons to the inch, as against 28 of gun metal. The bronzes is also converted into wire for electric telegraph purposes, and is being introduced for Post-office purposes in London; while samples are now being tested in Glasgow for similar purposes. Among the numerous other purposes to which the metal is being applied are for bell making, piano-forte wire making and the manufacture of jewel rings and other jewelry, which are in demand for the United States.

THE SIRHIND CANAL.

This great public work was opened with all due ceremony at Bombay, India, on the 10th ult., by the Viceroy. The Sirhind canal was first projected in 1840, for the purpose of utilizing the waters of the Sutlej, for irrigation purposes. Its total length is 502 statute miles, and when all the irrigation works are completed 2,500 miles of channel will have to be maintained. It is designed to irrigate 592,000 acres in British, and 261,000 acres in native states. The total cost was 407 lakhs, of which 278 lakhs were paid by the British Government, and 129 lakhs by the native states. It is the second large work of the kind undertaken in the Punjab since it has come under British rule. The management of the internal distribution of the water is left to the village communities, through whose territory the canals and branches pass, Government only interfering to prevent wilful waste. Col. Home of the Royal Engineers is in charge of the construction.

TURKISH PUBLIC WORKS.

The following official notice was published Dec. 5:

"Among the committees of reform recently instituted by Imperial decree, that concerning the study of the amendment to be introduced into the system of public works, for the progress and development of agriculture, commerce, and industry, has concluded the framing of by-laws to be adopted in conventions, and terms for conventions, rules for companies and the law of expropriation—all of which have been submitted to the Sublime Porte. These by-laws, which determine the bases and the conditions on which the Imperial Government will grant concessions for railways and roads, the establishment of harbors and canals, the draining of marshes, the navigating of rivers, etc., have been approved by the council of Ministers, and sanctioned by His Majesty the Sultan, who has been pleased to order that they be carried out in conformity with the Imperial decree."

The Ministry of Public Works having been authorized to proceed with the necessary formalities for granting concessions, the present notice is to give information to capitalists. The by-laws above referred to will be immediately published.

THE ENGLISH CHANNEL TUNNEL.

M. Léon Say in reply to a deputation of English Trades Unionists who waited on him on the 30th ult., said "that he had from the outset been one of the promoters of the tunnel, having been associated with the efforts of the late M. Michel Chevalier, and the more recent experiments had proved that its construction was perfectly feasible, and even easy. From a technical standpoint, therefore, success was certain. Economically, its utility could not be questioned on either side. It would make certain French Departments the market gardens of England, while France would reap the great advantage of being in closer relation with the supply of English manufactures. As to the military questions, it would not be becoming for Frenchmen to discuss them. They could only wait till public opinion in England was ripe. It was not for them to urge on England the parting with any of what she deemed her defences. This was a question solely for the English themselves. It was originally thought that an Anglo-French company would be best, but the different laws of the two countries as regarded public companies rendered it necessary to split the enterprise in two, and to create two distinct companies. The French company was a permanent one, and was quite ready to commence definitive operations as soon as England opened her door. It had not at present suspended boring—experiments were being made as to the probable cost. Thanks to these experiments, it was now certain that the outlay would not be so great as was at first anticipated. Beaumont's, and other English machinery were being used, and it was now almost certain that the tunnel could be constructed in five years. So much easier, indeed, had the work been found than was expected, that it was within a possibility of being completed in four, or even three years. It was important that its English advocates should show how greatly commercial interests would be benefitted by the scheme, while there could be no doubt as to the existence of a friendly feeling; to which Mr. Shipton, who brought over English aid to the distressed agriculturists of France after the war, could bear testimony. For the preservation of peace, friendly relations were more effective than fortifications. Many persons on this side of the Channel hoped the tunnel would soon be an accomplished fact; but it was not for them to take part in any movement for controverting the English military authorities. M. Say remarked that every precaution was taken by the French Government before submitting to the Chamber a Bill sanctioning the tunnel. It took care to ascertain that the English Government of the day were favorable to the scheme, and also that the representatives of the Opposition approved it.

The delegates then called on M. de Freycinet, when M. Adolphe Smith acted as interpreter on both sides—which duty he has fulfilled with admirable skill throughout the visit. Mr. Shipton explained that the object of the call was to offer a recognition of M. de Freycinet's eminent service in sanitary matters, both to London and other towns in England, by his treatises. Sanitary measures had always been regarded by the working classes as one of the best means of educating the masses. With sound, healthy bodies they would have sound minds, and nobody with a healthy mind would be an advocate of war. The Unionists also supported the tunnel, as tending to render war impossible.

M. de Freycinet, in reply, said he felt highly honored by the reference made to his works on hygiene. During his stay in England he visited a large number of factories, and he brought back with him the highest conception of England's power. It was at Liverpool and such ports rather than at Aldershot that he learned to admire the English people; and this experience led him to be a steady advocate of an alliance between the two countries. As a mining engineer, he has studied more particularly the geological phase of the tunnel scheme, and nobody was more delighted than himself at the discovery that it was practicable. He looked on the tunnel as a route, not for invasion, but for friendships, and as an additional link in the union between the two countries, which would help to dispel all military fears. These apprehensions would not stand the test of criticism. Even were England invaded, it could never be conquered or annexed. There were too much vitality and energy in the English for such a thing to be possible. The national feeling of the English people would raise a rampart which no power could overthrow. They would rise as one man. A slight protection at the mouth of the tunnel would render aggression impossible; and even if an invasion were ever effected, it would be by ships, whether the tunnel existed or not. He trusted that the enterprise would be persevered in, for the greatest advantages would accrue from such facilities of intercourse, and the study of each other's customs and habits. Frenchmen who, like himself, visited England, always returned with a feeling of enthusiasm, inspired by the contemplation of the industrial greatness and political freedom enjoyed by her people. It was the example he there saw that induced him to defend the cause of liberty in France, and he only wished the Continent enjoyed as much freedom as England. In England the working classes were wise enough to discard Utopian ideas, and confine their action within the limits of legality; while, on the other hand, the upper classes were sensible of the spirit of the times, and acceded to just demands. Had the same spirit of compromise existed in France many revolutions would have been avoided. From a commercial, political and social standpoint, therefore, Frenchmen were justified in desiring the tunnel, and its construction would be one of the greatest achievements of the 19th century."

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THE WATER SUPPLY OF EDINBURGH.

This was the subject of a paper read before a recent meeting of the Royal Scottish Society of Arts, in Edinburgh, by Mr. Alexander Leslie, M. I. C. E., etc. The author, after stating that the city is now in possession of a supply of water inferior to none in quantity, quality and cheapness, gave some particulars regarding the history of the water supply of Edinburgh, from the inauguration of the first gravitation supply in 1681, before which time Edinburgh had to rely on wells. He also detailed the parliamentary proceedings which led up to the appropriation of the present supply from Moorfoot. Going on to describe in detail the various Moorfoot works, he mentioned that the area occupied by Gladhouse reservoir was 390 acres, and that it was capable of containing 1,700 million gallons, while Portmore had an available capacity for 250 million gallons. It was estimated, he said, that when the whole of the works were completed there would be an available supply of 17 million gallons per day, or double what the maximum supply was before the Moorfoot water was introduced. Alluding to a prophecy that had been made, to the effect that the presence of large accumulations of water in the various districts would be damaging to the surrounding properties, by causing cold, damp winds, he stated that this view had been found to be erroneous; and that the farmers were of opinion that the land was benefited by the presence of the water, inasmuch as they found that the frost was much less intense than formerly.—*Contract Journal.*

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TRACK-LAYING is going on at the rate of half a mile a day on the western end of the Utah extension of the Denver & Rio Grande Railroad. It is expected that the line will be completed to Salt Lake by March 1, and that it will reach Ogden a month later. Ninety-eight miles of rails remain to be laid on the eastern end of the line, and twenty miles on the western end.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST......EDITOR AND PROPRIETOR.
S. D. V. BURR, A. M. ....ASSOCIATE EDITOR.

SATURDAY, DECEMBER 30, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6 50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price
Atlantic Monthly	$3.25	$4.00
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Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.25	1.50
St. Nicholas Magazine	2.55	3.00
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Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do this we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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NOTICE OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 127 East Twenty-third street, New York. The thirtieth annual meeting of the society will be held in New York, on Wednesday, Jan. 17, 1883, at 10 A. M. The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, proposed amendments to the constitution discussed, and other business transacted. Arrangements for Jan. 17 and 18 will be perfected by a committee, and you are invited to be present at the meetings on those days.

THE OHIO STATE ASSOCIATION OF SURVEYORS AND ENGINEERS.—The third annual meeting of the above Association will be held in Columbus, Ohio, on Jan. 17, 18, 19, 1883. There is every reason to believe that there will be a very full attendance of the surveyors and engineers of the State, and that the meeting will be of great interest and value. Parties expecting to attend the meeting will do well to notify early the Secretary, Benjamin Thompson, Urbana, Ohio.

COUNTY SURVEYORS' ASSOCIATION OF INDIANA.—The annual meeting of the association will be held at the County Surveyor's office, in the Court House, at Indianapolis, beginning on the 16th of January, 1883. Addresses on different subjects in regard to surveys, ditches and gravel roads are expected to be delivered, which will be of interest to the Indiana surveyors. An interesting meeting is expected.

HERVEY B. FATOUT,
Corresponding Sec'y.

THE MICHIGAN ASSOCIATION OF SURVEYORS AND ENGINEERS.—The Fourth annual meeting of the above association will be held at the State Capital, Lansing, Michigan, on January 9-12, 1883.

PROGRAMME.

TUESDAY, JAN. 9.—2 P. M.

Association called to order. Reading of minutes. Committee to examine surveyors' instruments appointed.

3 P. M.

Legislative needs of our profession.—Paper by George E. Steele, Grand Traverse. General discussion.

7.30 P. M.

Address of President, Prof. C. E. Greene of Ann Arbor. General discussion.

Construction and care of our common roads; by Burton Kent of Adrian. General discussion.

WEDNESDAY, JAN. 10.—9 A. M.

Difficulties in city surveying.—A. J. Teed, City Engineer, Cadillac. Discussion.

Construction and care of water-works suitable for small cities in Michigan.—Chas. B. Hyde, City Engineer, Jackson.

2 P. M.

Method of projecting parallels of latitude.—H. C. Pearsons, U. S. Inspector of Steam Vessels, Ferrysburg. Discussion.

Questions in practice.—I. H. Leavenworth, Engineer, Saginaw City. Discussion.

7.30 P. M.

Surveying instruments.—Prof. J. B. Davis, Ann Arbor. Remarks by manufacturers and others.

Report of Committee on Instrument Exhibit.

THURSDAY, JAN. 11.—9 A. M.

Reports of committees.—The manual; legislation. Discussion.

Railroading in Utah.—Frank Hodgman, Engineer, Climax. Discussion.

2 P. M.

Construction and operation of narrow-gauge railroads.—A. L. Reed, Chief Engineer P. H. & N.W. R. R., Port Huron, Mich. Discussion.

Logging railroads of Michigan.—E. F. Guild, Engineer, East Saginaw, Mich. Discussion.

7.30 P. M.

Traverse surveying.—Prof. J. B. Davis, Ann Arbor, Mich.

Engineering of town and county drains.—S. N. Beden, Engineer, Pine Run.

QUESTIONS OF PRACTICE.

In order to avoid waste of time it is important that such questions be arranged and given some consideration before our next meeting. Mr. I. H. Leavenworth, of Saginaw City has kindly undertaken this task. It is to be hoped that enough queries will be submitted to cover most of the difficult points in practice. Questions on which the opinion of the Association is desired should be sent at once to Mr. Leavenworth or the Secretary.

EXHIBIT OF SURVEYING INSTRUMENTS.

By a special vote of the members at the last meeting an exhibit of surveying instruments will be held at our coming meeting. We invite each member to exhibit his instrument of practice, whether good or poor, and shall provide proper place for such an exhibit. We especially invite manufacturers to exhibit instruments of their own make. If they can attend our meeting personally, we offer them a place on our programme. To our members we will say that we hope to induce one or two of the most noted manufacturers to be present with us.

ENTERTAINMENTS.

The hotels in Lansing will give the following rates to members of the Association:

Lansing House	$2.00	per day.
Hudson House	2.00	"
Chapman House	1.25	"
Goodrich House	1.25	"
Everett House	1.00	"

INDUCEMENTS TO ATTEND.

Each member of the association should arrange his work so that he can be in attendance throughout the whole meeting. The advantages to be attained may be stated briefly as follows: Mutual instruction, which in time will be evident in a more uniform practice; acquaintance and good feeling toward fellow laborers, which cannot be estimated in money; an opportunity, at small expense, to see the attractions of the State capital during a session of the Legislature.

Surveyors or engineers, not members, should embrace this opportunity for joining the association.

PROF. H. C. CARPENTER, Lansing, Mich., Secretary.

THE PANAMA CANAL.—Yesterday we were informed at the office of the Franco-American Trading Company that they had closed the largest contract yet given for work on the Canal. The contract extends over 16 kilometers, commencing at Panama, and the amount to be excavated is from 8 to 10 millions of cubic meters. The machinery for doing this work will, probably, be obtained from the Pound Manufacturing Company, of Lockport, N. Y.

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AMERICAN SOCIETY OF CIVIL ENGINEERS.

Mr. Wm. P. Shinn, M. Am. Soc. C. E., read a paper on the "Increased Efficiency of Railways for the Transportation of Freight," at the regular meeting of the society on the 20th. We present the following abstract: The first portion of the paper gave from carefully gathered statistics, a valuable amount of information in regard to the actual increase of traffic upon American railways. In 1860 the tonnage mileage of the New York Central & Hudson River Railroad, the Erie Railway and the Pennsylvania Railroad was about equal, and amounted in the aggregate to a little over three-fourths of that of the New York State canals, and in 1870 each of these railroads averaged about the tonnage of the canals; and in 1880 they averaged each nearly double that of the canals.

The aggregate tonnage mileage of the other railroads was, in 1881, 1217 per cent. more than 1860. Statistics were also given showing the increase of population, of railroad mileage, of the production and export of grain and other leading exports. The means by which this rapid increase of freight transportation had been developed was considered under two general heads, namely, improvements in the physical conditions of the railroads, and improvements in the administration. The improvements in the physical condition were treated on under these heads:

1. Improved track or "permanent way," including bridge structure.
2. Additional sidings and second, third and fourth tracks.
3. Increased capacity and strict classification of locomotives.
4. Increased capacity of freight cars.
5. Additions to terminal facilities.

The improvements in the administration were referred to under the following heads:

6. Improved methods of signaling.
7. Running locomotives "first in, first out," and running freight trains at higher rates of speed.
8. Consolidation of connecting lines under one management by purchase, lease, amalgamation or otherwise.
9. Running freight cars through from point of production to tide water without transshipment.
10. Issuing through bills of lading (or freight contracts) from Western points of shipment to Atlantic and European ports.

The general introduction of steel rails was stated to be the very corner-stone of increased efficiency. The improvements in all the directions referred to were treated of and described at considerable length.

The second portion of the paper presented the writer as to the means whereby still greater efficiency could be most economically obtained. The constant demand is for more transportation facilities, for more cars. In the opinion of the writer what is needed is not so much more cars as movement of cars. Freight blockades will be prevented, not by having more tracks to stand cars upon, but by having fewer standing cars. It was shown that upon one railway there had been a decrease in the miles run by the cars of 21 per cent. between 1868 and 1881, and that the Union Line cars between 1879 and 1882 were increased 49 per cent., while the mileage run by them decreased 16 per cent. in the same period. The remedies suggested by Mr. Shinn were: More main tracks, more locomotives, more trains, the improvement of the making up of trains at the points where cars are loaded. The detention of cars at stations and private sidings and the absence of cars on foreign railroads were considered as among the greatest causes of loss, and the writer suggests that the remedy will be to charge a per diem charge for cars when on foreign roads, and that this charge should be based upon the average economic value of the cars in use to their owners.

The paper was discussed by Messrs. T. C. Clarke, G. S. Greene, Jr., W. C. Andrews, C. Macdonald, C. E. Emery, and by the author.

By a vote of the Society it was directed that this paper should be discussed at the annual meeting. Members of the Society and others interested in this subject are requested to contribute to this discussion. The annual meeting of the Society will occur January 17 and 18, at the Society house in New York. The first session of the meeting will be at 10 a. m., January 17, 1883.

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PERSONAL.

F. C. HAND has been appointed superintendent of the San Pete Valley Railroad and Central Pacific Coal & Coke Company, vice F. S. CAHILL, resigned. Headquarters at Wales, Utah.

Professor ROBERT FLETCHER, of the Thayer School of Civil Engineering in Dartmouth College, and the students of that department, started Tuesday on their annual tour of inspection of public works, visiting first Boston, Watertown, Lowell and Lawrence.

Mr. William Lush, resident Civil Engineer, has been appointed Assistant Chief Engineer of the New York Central & Hudson River Railroad, with headquarters in this city. Mr. Gould, an assistant of Mr. Lush, takes the place made vacant by the latter's promotion.

Mr. Graham Smith, C. E., who last January was appointed Port Engineer; Rangoon, has resigned that appointment, stating as his reason that the Commissioners will not supply him with the necessary ways and means to perform his duties. The Port Commissioners have, however, declined to accept the resignation, and have requested him to complete the agreement with them for five years.—*Calcutta Englishman, Nov.* 8.

Mr. D. Bontecou, Mem. A. Soc. C. E., of the firm of Knight & Bontecou, Civil Engineers, Kansas City, Mo., is spending the holiday season at his old home in this city. Mr. Bontecou was formerly connected with the Park Department of New York, but in 1880 opened an office in Kansas City for general engineering business. The firm has been very successful. Mr. Knight is City Engineer of the most enterprising city west of the Mississippi; and Messrs. Knight and Bontecou are engineers for several enterprises, among which may be mentioned the Kaw Railroad Bridge, the Kansas City Belt Railway, the Inter-State Fair Association, Union Depot Company, and the Kaw Valley Town Site and Bridge Co.

VIBRATIONS IN BRIDGES.

Prof. S. W. Robinson in a report, included in the forthcoming report of the Ohio Railroad Commissioners, submits the following very interesting remarks on cumulative vibration in bridges;

It is a well-known physical fact that rhythmical impulses, though very slight individually, will result in an astonishing cumulative action when applied for a time to a body so circumstanced as to vibrate in equal rhythm. Soldiers in marching must break step in passing over foot bridges, else, if the bridge should have a time of vibration equal to the time of step, the structure would vibrate seriously. The trot of a dog has been observed to cause a street bridge to vibrate with decided intensity, the vibration being observed to keep time with the dog. Horses in vehicles "must not move over the bridge faster than a walk," for fear the trot and vibration periods shall agree. The child in a swing is able to rise from a low to a high altitude without help, simply by a tilting motion of the body, so directed that each adds a slight impulse to the oscillatory movement. Similarly in railroad bridges a slight want of perfect balance of the locomotive driving-wheels may cause unexpected vibrations and unanticipated strains when the times of half revolution of drivers harmonize with the bridge vibration time. The likelihood of such synchronism may be rendered more apparent by means of calculated results. For example, a train moving at the rate of 30 miles per hour has a velocity of 44 ft. per second. Locomotive drivers of 5½ ft. diameter make one revolution in about 0.4 second, or a half revolution in 0.2 second.

Now, an iron bridge of 150 ft. span will weigh about 1,400 lbs. per foot. In vibrating vertically, as by placing a heavy load upon it suddenly, the ends at abutment do not participate, while the middle is most active. To get an approximation, without going into refinements as to distributed masses, suppose half the bridge length to vibrate equally while the quarters near the abutments do not vibrate, then half the weight of the bridge will enter into account for vibration, or 105,000 lbs. Next, let us suppose a train moves rapidly on it in which the drivers are out of balance; if the bridge vibrates, the engine and train to abutment will vibrate with it, so that a portion of vibratory mass must be added. Taking the weight of the train at 2,000 lbs. per foot, the half span, or 75 ft., will weigh 150,000 lbs. Finally, let it be supposed that the static deflection of the bridge for this train-load is 1 in., which is about that found for such cases. Now, by the principles of dynamics, the time of vibration for this case, supposing the load at the center of bridge, is found to be

$$t = \pi \sqrt{\frac{W d}{w g}}$$

Where W is the total load, 105,000+150,000 = 255,000 lbs., w the added load = 150,000 lbs., d = the static deflection, = 1 in., or $\frac{1}{12}$th ft., and g = the acceleration of gravity = 32, nearly. Introducing these and reducing we find the time of a simple vibration to be 0.2 second, a value which agrees with the time of revolution of the drive-wheels. Hence, unbalanced drivers will here cause vibration, with a period of 0.2 second. The period from the highest point back to that point of movement will correspond to the entire revolution, or 0.4 second of time. This will cause 2½ complete movements per second and is the period which would be noticed by an observer.

Similarly, a bridge of 300 ft. span weighing 2,000 lbs. per foot, undergoing a static deflection of 2 in. from a freight-train load of 2,000 lbs. per foot will vibrate in a period of 0.35 second. A double vibration, which corresponds with the time of revolution of a drive wheel, would be made in 0.7 second. This time of revolution of 4-ft. drivers answers to a train speed of about 11½ miles per hour or 14½ for 5-ft. drivers. This case answers fairly to freight trains. Hence, it appears that bridges are liable to become badly shaken from cumulative impulses, those of 100 to 200 ft. span by passenger trains and those of 200 to 400 ft. span by freight trains. To estimate the amount or intensity of this action, first consider passenger trains. To this end we will take advantage of the calculations of Mr. J. W. Cloud, of Altoona, Pa., Engineer of Tests for the Pennsylvania Railroad. The results of his calculations are given in a valuable paper, evidently prepared with much care, on "Shocks on Railway Bridges," and read before the American Institute of Mining Engineers, February, 1881. His calculations are for a locomotive of the Pennsylvania Railroad, Class B, the weight of which in running order is 73,100 lbs. Drive-wheels, four in all, are 62 in. in diameter; weight of tender, loaded, 49,800 lbs.

The shocks that Mr. Cloud calculates are those due to the centrifugal force of the counterbalance weights in the drive-wheels, and considered as acting upon the bridge like a hammer with repeated blows, but without supposing synchronous bridge vibration to follow. These calculations, as far as the downward and upward thrusts from centrifugal force are concerned, are exactly to our purpose. At a speed of 50 miles per hour, these thrusts for each of the four wheels are given at 6,260 lbs., and act downward when the counterweight is down, and upward when the counterweight is up, the two being repeated 4¼ times every second. For our present purpose we must find the effect of all the wheels on the bridge, supposing the latter to vibrate in synchronism.

Now, as the wheel revolves, the centrifugal force acts in the direction of a radius through the counterweight, but this radius revolves with the wheel. For a half revolution there is a component downward, and for the other half there is a component upward. The resultant effect for a half revolution is about the same as though two-thirds of the force acted constantly for the half revolution downward, and then for a half revolution upward. Hence, for a single wheel the two-thirds of 6,260 is 4,173 pounds. Now, to include the effect of the four wheels, it appears, from the fact that opposite wheels have cranks at right angles, the resultant of forces in a right angled triangle should be taken for each pair of wheels, giving 1.42 × 4 173 × by 2 pounds = 11,851 pounds for the combined action of all the wheels, in the form of a constant force for a half revolution. This is equivalent in its effect upon the bridge to that of all the counterweights. Now, it is well known by the principle of dynamics that the dynamic deflection due to this force is twice the statical. The latter can be found by simple proportion, in a comparison of the 11,851 lbs. with the train-load of 150,000. If the latter produces a deflection of 1 in., the former will cause a statical deflection of 0.079 in., which will be downward for the downward force, and *vice versa*. Calling these points of static deflection neutral points, we have for cumulative synchronous vibration the first dynamic downward deflection, equal to 2 × 0.079 = 0.158 in., with the lower neutral point at the middle of the amplitude. Now, because the force is reversed, the return amplitude will be such that the upper neutral point divides it equally, from which it appears (by aid of a sketch) that the latter amplitude is three times the first. The next amplitude, downward, with lower neutra point central, will be such as to reach a point in descent which is below the first lowest point of deflection, by a distance which equals four times the statical deflection. Now, by the continuation of this action, the force being supposed to reverse with the motion, each succeeding point of descent will be lower by a fourfold statical deflection, or by 4 × 0.079 = 0.316 in. Similarly for the upward movements.

Now, as he wheel makes about five complete turns along the central part of the bridge, we find this fourfold deflection to be repeated five times, giving us a resultant total deflection, due to the cumulative action, of 5 × 4 × 0.079 = 1.580 in., a deflection which is in excess of that due to the whole load of 150,000 lbs., viz.: 1 in., by over 50 per cent. Hence, the cumulative action more than doubles the strain on the bridge. From this it appears that an iron bridge, calculated for the usual statical strain of 10,000 lbs. per square inch, would, from the additional cause now considered, be strained to 25,800 lbs. per square inch, a strain which is fully up to the elastic limit, and hence such a bridge would be in imminent danger of destruction. The individual impulses will vary as the square of the velocity, or speed of the trains, so that, for about 35½ miles per hour, the superadded strains will be only half what they are found for the above case of 50 miles per hour. But one point to be noted is that during a run of 100 or 200 miles, at a stated speed of 30 miles per hour, an occasional speed of 50 may be reached, and this, likely enough, at the critical moment of crossing a bridge.

For freight trains at 15 miles per hour, with 4 ft. drivers, a single impulse is only about one-seventh that for 50 miles, as above. But as the bridges attacked are twice as long, and the number of impulses twice as great, the resultant effect is about one third that for the 50-mile speed, and hence causes a 35 per cent. superadded strain. This action is believed to be a potent cause in the destruction of bridges, because the drive-wheel system is never exactly balanced. But such vibration is not expected for every train nor every bridge. The reason well authenticated instances of its occurrence are not plenty is probably due to the fact that observing persons are not often in the position to detect it. Cannot the survivors of the St. Charles bridge disaster explain? At least one case occurred in the experience of the writer, causing personal alarm for the second and a half that the engine was apparently jumping along the bridge. It was during a ride in the cab of an engine, while seated and leaning out of the window; the bouncing was decided, and with no mistake, because the ride in this position was taken for the express purpose of seizing upon any peculiar incident or phenomenon. It furnishes a striking corroboration of the above calculations.

CONDITION OF CHICAGO WORKING MEN.

The Chicago *Tribune* gives some interesting extracts from the biennial report of the Secretary of the Illinois Bureau of Labor Statistics. The facts in regard to the condition of working men in Chicago are derived from statements made to the bureau, in reply to interrogatories, by 437 working men, representing 62 different vocations in life, and of a great diversity of condition. Of the whole number reporting, only one-eighth are possessed of homes of their own. A table is presented in the report representing the status of a class of persons who occupy a middle position between the very poor and the more prosperous among the working men, and giving the annual average earnings in each trade or occupation, the number of persons to a family, the number of rooms occupied, and the monthly rental paid. It appears from this table that the average annual income of working men of all occupations in Chicago is $608.70. Two trades show incomes of over $900, five average more than $800, nine average upward of $700, and nineteen upward of $600 per annum. The average family of the working man, as shown in these returns, consists of four persons. The average number of rooms occupied by a family of four is three and one-third. Instances are given in which one room is occupied by a family of six. These are, however, few. In fact, only 6 per cent of all the families reported from are compelled to occupy one room, and about one-half of these are families of two. Twenty per cent. of all the families reported live in two rooms, and one-half of these families have from four to nine members. The average rental paid for three and one-third rooms is $10.25 per month. The greater number of families occupy three or four rooms at a cost of about $3 per room. In order to obtain these tenements at these prices, however, it is necessary to live in the outskirts of the city. This involves the payment of car fare, which increases the rent item about 33 per cent. In this way it is estimated that the laboring man pays about 27 per cent. of his earnings for shelter for himself and his family.

STEAM-ROLLING FOR THE MAINTENANCE OF ROADS IN THE ARDENNES.*

BY M. LANCRENON.

In the southern portion of the department of the Ardennes, and the adjacent districts, the maintenance of the roads is peculiarly troublesome, owing to the high price of suitable material and the chalky soil. The chalk, readily absorbing moisture, is disintegrated, when damp, by the frost, which causes it to swell and become pasty, and the roads formed over it are soon damaged. The only remedies are to keep out the frost by a thick layer of road metal, or to prevent the damp from reaching the chalk by forming an impermeable coating. The first remedy was too costly in most cases, and the partial methods of repair pursued up to 1878, though performed with great care, were too imperfect to secure the second result. A ministerial circular in 1878 having advised the extension of the system of maintenance by spreading layers of metalling across the road and rolling, it was decided to commence this system in 1879. Owing to the unfavorable winter of 1879-80, the work of repair got so behindhand by the autumn of 1880 that at least six rollers, each drawn by eight to eleven horses, whould have been required, with the necessary appendages of water, tools and pumps, at a season of the year when the transport of beet-root and other circumstances raise considerably the cost of hiring horses. A trial of steam-rollers was consequently decided upon. The material to be spread on and rolled in the winter of 1880-81 amounted to 10,700 cubic yards, over a length of 18½ miles. The steam-roller was provided by the person who had the contract for rolling the streets of Paris; it weighed 26 tons. The road metal was laid on and well rolled, and then it was intended to spread thin layers of sand in succession on the top, rolling each layer so as to fill up the interstices. The calcareous sand, however, which had proved satisfactory under ordinary rolling, was crushed between the metalling and the roller; it became pasty, and stuck to the roller, sometimes dragging up the metalling with it. Water was then resorted to for preventing this action, but whenever there was a deficiency of moisture in the sand, owing to fresh portions being crushed as the roller advanced, the adhesion again took place. Next, sand was spread on the consolidated road metal, and the road opened for traffic; but the sand did not settle gradually into place under the wheels of the vehicles as anticipated, and the metal was disturbed by the horses' feet. Metalling alone was then tried, being thoroughly rolled; but the cost was excessive, and a portion of the material was crushed. An attempt to form the road by mixing together the metalling and road scrapings previously to rolling also failed. Drenching the road with water proved successful, but this could rarely be done. Quartzite sand from the Meuse was thought of as a substitute, but the Meuse was in flood, and all the other sand had been delivered. At last the plan of thoroughly consolidating the metalling with the steam-roller short of crushing it, and then, after spreading the full layer of sand over the road rolling it with an ordinary roller, proved successful, and the work was completed in this manner. The detailed financial results of the process are given in a set of tables.

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* Abstracted from *Annales des Ponts et Chaussées*, 1882, Vol. III., p. 437, and published in "Abstracts of Papers in Foreign Transactions and Periodicals," Vol. LXIX., Part III., by the Institution of Civil Engineers.

The method of maintenance by spreading layers of metal across a road has the advantage of forming a new regular surface, free from depressions, such as cannot be obtained by patching. Many portions of a road, though very uneven on the surface, have sufficient metal on them to need only a thin, fresh coating; and it is, therefore, generally advisable to reduce the thickness of the layers to a minimum, and increase their length. The amounts adopted after numerous trials were 526 cubic yards per mile for a road 13 feet wide, and 630 cubic yards for a 16½ ft. road. Picking the old surface is the best method of uniting the new and old layers, but it is costly, and, in most cases, picking at the sides, cleaning the old surface and watering when necessary, suffice with heavy rollers. The water is applied after the new layer has been deposited, to prevent its flowing at once into the ditches. The auther considers it would be a great improvement to place the water-supply on the roller-carriage, so that the watering might be done by the driver when and where required. The steam roller consolidates the metalling better than a horse-roller, owing to its weight and its freedom from the disturbance produced by the horses' feet, especially on ascents. In rolling with horse-rollers the stones take longer in settling into their places, and are also more rounded and crushed, as shown by the fact that 2 cubic yards more sand per mile are required with a steam-roller. It was found that nine passages of the steam-roller over the same spot sufficed to consolidate the metalling, and that any further rolling only produced crushing. The steam-roller, weighing 26 tons, costs considerably more to transport from place to place than the ordinary roller, weighing only about 8 tons; but its weight, together with its greater speed, reduce greatly the time occupied in rolling. The cost of rolling with an ordinary roller is reckoned at 18d. per cubic yard of the material; and the actual cost of rolling with the steam-roller amounted to 14.7d., 17.7d., and 18.4d. for the same work. The author, however, considers that the work might be done much more cheaply by purchasing a roller instead of employing a contractor. The yearly cost of the machine is estimated as follows:

Driver	£120
Stoker	90
Pilot	80
Night watchman	20
Fuel	260
Grease, waste, etc	30
Capital charges and repairs	300
	£900

The expenditure on rolling 19,600 cubic yards, the amount of material required for repairing the roads of the department, gives 11.7d. per cubic yard, and adding 1.1d. for supplying the machine with water, the total cost of rolling would be 12.8d. per cubic yard, a much lower price than could be attained by a horse-roller. The author concludes by explaining how the system of steam-rolling could be organized under similar conditions, and he estimates the cost of transforming 1 cubic yard of material into a good road as follows:

	d.
Picking the sides and cleaning the road	1.1
Spreading and application of materials	4.0
Watering	1.5
Feeding the machine (35⅓ cubic ft. per hour)	1.1
Supply of sand	4.4
Application of sand	1.1
Costs of the machine	11.7
	24.9 = 2 s. 0.9 d.

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WHERE DIPHTHERIA OCCURS.

LIKE TYPHOID FEVER, IT IS MORE OF A DISEASE OF THE VILLAGE THAN OF THE CITY.

The mortality statistics collected by the Census Bureau furnish some interesting points with regard to the distribution of certain diseases. The number of deaths during the census year reported as due to diphtheria is, males, 18,849; females, 19,549; total, 38,398; giving a proportion of 51.33 per thousand of all deaths in which the causes are reported. The total number of deaths from diphtheria under one year of age was 2,896; under five years of age it was 20,035; between five and fifteen years of age, 16,162. In the North Atlantic States the proportion of deaths from diphtheria to the total number of deaths having recorded causes was 51.29 per thousand, being in the cities 46.71 per thousand and in the small towns and rural districts, 53.80. In the Gulf Coast States the proportion of deaths from diphtheria was but 12.16 per thousand (13.74 in New Orleans and 12.27 elsewhere), and in the Lake regions it was 81.15. Six cities, from Rochester to Chicago, give an average of 78.15, and the remainder of the region 84.10 per thousand. The statistics of enteric or typhoid fever are equally instructive. The total number of deaths from typhoid fever reported are: Males, 11,852; females, 11,053; total, 22,905, being in the proportion of 31.21 per thousand of all deaths having reported causes. In the North Atlantic States the proportion of deaths from this cause was 16.26 per thousand in the large cities and 19.95 in the country. In New Orleans it was 7.67 and in the rest of the Gulf States 30.02. In the Lake region the deaths from typhoid were 17.16 per thousand in the large cities and 27.31 in the remainder of this region. It will be seen from these figures that neither diphtheria nor enteric fever are especially diseases of the large cities. They appear to be more prevalent in the small towns and rural districts which have no general water supply or systems of sewerage, but obtain their water from springs and wells and observe the usual custom of storing excreta in cesspools or vaults.

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THEIR FIRST APPEARANCE.

Envelopes were first used in 1839.

Anaesthesia was discovered in 1844.

The first steel pen was made in 1830.

The first air pump was made in 1654.

The first lucifer match was made in 1798.

Mohammed was born at Mecca about 570.

The first iron steamship was built in 1830.

The first balloon ascent was made in 1798.

Coaches were first used in England in 1569.

The first steel plate was discovered in 1830.

The first horse railroad was built in 1826–27.

The Franciscans arrived in England in 1224.

The first steamboat plied the Hudson in 1807.

The entire Hebrew Bible was printed in 1488.

Ships were first "copper bottomed" in 1783.

Gold was first discovered in California in 1848.

The first telescope was used in England in 1608.

Christianity was introduced into Japan in 1594.

The first watches were made at Nurenburg in 1477.

First saw maker's anvil brought to America in 1819.

First almanac printed by Geo. Von Furbach in 1460.

The first newspaper advertisement appeared in 1652.

Percussion arms were used in the U. S. Army in 1830.

The first use of a locomotive in this country was in 1829.

Omnibuses were first introduced in New York in 1830.

Kerosene was first used for lighting purposes in 1826.

The first copper cent was coined in New Haven in 1687.

The first glass factory in the United States was built in 1780.

The first printing press in the United States was worked in 1620.

Glass windows were first introduced into England in the eighth century.

The first steam engine on this continent was brought from England in 1753.

The first complete sewing machine was patented by Elias Howe, Jr., in 1846.

The first Society for the Promotion of Christian knowledge was organized in 1698.

The first attempt to manufacture pins in this country was made soon after the war of 1812.

The first prayer book of Edward VI. came into use by authority of Parliament on Whitsunday, 1549.

The first temperance society in this country was organized in Saratoga County, N. Y., in March, 1808.

The first coach in Scotland was brought thither in 1561, when Queen Mary came from France. It belonged to Alexander Lord Seaton.

The first daily newspaper appeared in 1702. The first newspaper printed in the United States was published in Boston on Sept. 25, 1790.

The manufacture of porcelain was introduced into the province of Hezin, Japan, from China in 1513, and Hezin ware still bears Chinese marks.

The first society for the exclusive purpose of circulating the Bible was organized in 1805, under the name of the British and Foreign Bible Society.

The first telegraphic instrument was successfully operated by S. F. B. Morse, the inventor, in 1835, though its utility was not demonstrated to the world until 1842.

The first Union flag was unfurled on Jan. 1, 1776, over the camp at Cambridge. It had thirteen stripes of white and red, and retained the English cross in one corner.

When Capt. Cook first visited Tahiti, the natives were using nails of wood, bone, shell, and stone. When they saw iron nails they fancied them to be shoots of some very hard wood, and, desirous of securing such a valuable commodity they planted them in their gardens.—*N. Y. Sun.*

NOTES.

GOVERNMENT RAILROADS IN GERMANY.

Consul General Vogeler has made an interesting report to our Government on the results of the Government control of railroads in Germany. The principle of State influence in the management of railroads was applied in the early days of railroad construction. In 1838, a Prussian law imposed a sinking fund tax on railroads, with a view to paying off the capital employed, in order that the roads might after that be run at the cost service, and it was provided further that, at the expiration of a certain time, the State should have the privilege of buying the roads. In 1843 Prussia began to subsidize and build railroads, and from 1849 to 1850 taxes were imposed to buy up railroads, as a part of the systematic policy of the Government. In 1873 a Government commission reported that it was desirable to transfer to the empire the general supervision of German railroads and to regulate them by imperial laws and tribunals. In 1876 Prussia offered to make over all her railroads to the Imperial Government, but the smaller States were alarmed at this, and some of them anticipated the Imperial Government by buying up the roads in their own territory. Public opinion, according to Mr. Vogeler, has grown more favorable to State ownership. In Prussia, more than four-fifths of all the lines are owned or operated by the State. The receipts of the State roads increased 8.6 per cent. in 1880–81, and the expenditures only 1.9 per cent. The gross profits in 1879–80 were about $38,000,000, and in 1880–81 about $40,000,000, the latter sum representing an annual return of 5 per cent. on the capital which Prussia has invested in her railways. Adding to these railways the lines in the provinces of Alsace-Lorraine, it appears that more than one half of all the lines in the empire are virtually under Imperial control. On the Prussian State railroads, 112,446 men are employed, who constitute a pretty solid voting force for the Government.

GIANT POWDER PATENT SUIT.

PITTSBURGH, Dec. 20.—An important suit has been entered in the United States District Court by the Atlantic Giant Powder Company of California, against Marcus Hulings of this city. It is a suit in equity for infringements of patents held by the complainant company covering certain processes employed in the manufacture of nitro-glycerine, giant powder and almost all other explosives. If the patents are held to be valid it will give the complainant almost a monopoly of the manufacture of explosives in the United States, which will be far more valuable than the Roberts torpedo patent. Counsel for the defendants moved to dismiss the bill, which motion was overruled, and sixty days' time was granted to file their answer. The same company also brings action in equity for infringements of the same patents against Wilson & Barr, Boland & Barr, and J. G. Howe *et al.*

Driven Wells Decision.

Washington, Dec. 20.—Judgment has been rendered by the United States Supreme Court in the case of Wahl against Hine, sustaining the validity of the patent known as Green's driven well patent, and the right of the patentee and his assignees to collect royalties from the users of the wells. There are many of these wells in use, and there are several hundreds of cases pending in the circuit courts throughout the country for royalties, which will also be determined by this decision of the Supreme Court.

A memorable year in the history of artillery science has ended with some conclusive experiments at Spezia. The new steel and compound armor plates are shown to be able to withstand any known projectile, even the 2,000-pound Whitworth steel shot from the new 100-ton gun. Artillerists abandon the idea of perforating the armor of the future, and will now turn their attention to the construction of larger guns and the use of enormous projectiles, so as to gain the greatest possible total energy of blow. Hereafter the effort will not be to perforate a ship's armor, but to crush in her whole side by the impact of a projectile, weighing two or three tons, and having a striking velocity of 1,500 ft. per second, and a total energy of about 100,000 ft. tons. With such ordnance it becomes not so much a question of the vessel's exterior armor as of her structural strength. The 100-ton breech-loader used is 39 ft. long, 17 in. bore, takes 700 pounds of powder at a charge, carries a shot weighing a ton, and can be loaded, aimed and discharged by the hand of a lady in less than one minute, so simple is the machinery by which it is operated. It was powerless, however, against the new steel and compound armor.

GENERAL INTELLIGENCE.

☞ We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.

GAS AND WATER.

Chicago Water Works.—Up to the 1st of January there will be in use about 514 miles of water-pipe, something less than 20 miles having been laid this year, at a cost of nearly $200,000, including hydrants, stopcocks, etc. The quantity of water supplied during the year will amount to about 25,000,000,000 gallons, or an average of nearly 70,000,000 gallons per day. There have been nearly 6,000 service pipes attached during the year, about 70 elevators put in, and 225 water-meters. The remainder of the superstructure of the lake crib has been built, two new pumping engines for the West Side pumping works are well under way, and the foundations in course of construction. The cost of the engines, foundations and buildings will be close to $400,000.

The Equitable Gas Light Company, of this city, has been chartered by the commission. The company agrees to furnish gas to the public at $1.75 per 1,000 cubic feet, and to pay the city 20 cents for each lineal foot of mains laid. The street lamps are to be lighted for $12 each a year. The rates of the new company will be much lower than those charged by the old companies.

New Water-Works.—Wichita, Kan., Dec. 22.—St. Louis capital is building a complete system of water-works in this city.

The Hartford, Conn., Gas Company has voted to reduce the price of gas 5 per cent.—from $2 to $1.90 per thousand ft.—the reduction to date back from Dec. 1. For the city lamps they reduce from $1.90 to $1.80.

An Untamed Pump on the Rampage.—A man erected some kind of new fangled pumping apparatus for a rancher at Paradise Valley. The pumping machine was to be driven by wind. The other day when a ten-knot breeze was blowing the inventor "turned her loose." In about half an hour the machine flooded the cattle corral with water and floated away the butt end of a haystack. The ranchman yelled to his machinist: "Stop her! stop her!" but it happened that provision for stopping was what the inventor had not thought of. Had it not been that the well was soon pumped dry the whole ranch would probably have been washed away. Even after the well was dry the machine threw mud and gravel so wickedly that to approach it was unsafe. —*Territorial Enterprise.*

ELECTRICITY.

Electric lights are to be placed in all the rooms on the main floor of the new capitol at Albany. Among the rooms which will be thus lighted are the Governor's apartments, the Secretary of State's and the Attorney-General's. No attempt will be made to light the large halls used by the legislature with the electric lamps, a previous trial of them having shown that they do not give a steady enough light for the members to write with ease at the night sessions. It is probable that the stone ceiling of the assembly chamber will be sufficiently repaired to permit of the room being used by the assembly when that body meets on Jan. 2.

The Electric Light and the Fog.—During the recent extraordinary fog the Edison Electric Light Company, recognizing the necessity for distributing the light to their customers without intermission, maintained their dynamos in action at Holborn Viaduct for a continuous period of 64 hours without stopping. Starting at 3 o'clock on Saturday afternoon, December 9, the dynamos ran without ceasing during Saturday, Sunday, Monday, and Monday night, stopping at eight o'clock on Tuesday morning, December 12. This had not previously been done in England, and was not accomplished by the other electric light companies in the city. The current was supplied from two large dynamos which are used alternately, and during this long run the current was switched off from one dynamo on to the other, or back again, five times by means of a peculiar switch, which enables this to be done without in the least degree interrupting the lighting. The incandescent lamps in the shops on Holborn Viaduct and in the street were thus maintained during the whole of this time.—*London Ironmonger.*

The Lighting of Hell Gate.—Mr. A. A. Hayes and Mr. Brush, of the Brush Electric Light Company, are at present in Washington in consultation with the Lighthouse Board on the subject of illuminating Hell Gate by electricity by the Brush system. The Brush Electric Light Company recently submitted to the Lighthouse Board a model of an iron tower, of skeleton design and in shape an obelisk, with a glass cupola cap on top to protect the light, approached by an elevator ascending the center of the tower. This design was rejected by the Lighthouse Board, who objected to the use of tubular iron which was necessary to the plan, and Messrs. Hayes and Brush will obtain instructions from the Lighthouse Board.

STREETS, DRAINAGE, ETC.

Some contractors were in Council Bluffs, Iowa, the other day looking after a chance to pave Main street and Broadway with a macadam of Sioux Falls granite. They propose to put on six inches of limestone macadamized, and on top of this six inches of the granite, and say the cost will be about $2.25 a yard.

CANALS.

The Florida Canal.—The dredge of the Okeechobee Drainage Company, working up the Caloosahatchee River, entered Lake Okeechobee on the 20th inst. This opens a navigable channel from the heart of the Everglades to the Gulf of Mexico, an important event in the history of Florida, as it opens up extremely rich sugar lands.

RAILROADS.

Winter Work on the Northern Pacific.—The advance of winter in no perceptible degree serves to check railroad building in Montana. The Northern Pacific continues in the field with large forces of men, and grading and track-laying are going ahead east and west on the converging ends. Strong bodies of graders are assaulting the Belt Range, west of the Yellowstone, and every hour of the 24 is utilized in pushing the work over the divide. Huge fires blaze on the mountain sides, lighting up the busy scene of operations at night time, and pick and shovel, blast and barrow, are kept employed by gangs of scores and hundreds without a moment's stop or intermission. The steel-railed track, parting from the Yellowstone, which it has followed in one unbroken stretch of 300 miles, is now surmounting the most formidable barrier on the line of the road, and in a fortnight, or three weeks at most, will have reached the Valley of the Gallatin and sighted the Three Forks of the Missouri. Every effort is being put forth to finish up the several cuts and fills on the range, toward which the track layers are marching, at the rate of a mile a day. By New Year's day the whistle of the locomotive will be within hearing distance of Bozeman, and before the first month of 1883 is gone construction trains will be landing rails and other building material at and west of that point. November and December have been exceptionally moderate, and should the weather continue as favorable as experienced thus far, we may expect a completed track to Gallatin in February and to Helena by June. From the West, with progress continued as now, Missoula will be reached by March and the western side of the Main Range before the end of June. It is perhaps possible to make the continental connection by July 4, but the meeting of the two ends we place at a little later day, and the place which will witness the important event will likely enough be the summit of the Rocky Mountains, 15 miles west of Helena.—*Helena (Mont.) Herald.*

A note from Albany, Ga., states that the president of the Brunswick & Albany railroad has ordered the construction of the line into Albany and towards Montgomery.

Two thousand men and 1,000 horses are now employed on the Ontario and Quebec, between Toronto and Montreal. One-third of the road, which will be about 300 miles long, is now graded. Tenders for rails will soon be invited, and it is expected by this time next year through trains will be running.

The extension of the Chicago and West Michigan railway to the mouth of Muskegon lake is being pushed forward rapidly and the track has been laid partly along the beach of Lake Michigan.

It is stated that the work of completing the double track on the Grand Trunk between Toronto and Montreal, will be commenced in the Spring.

The United States Cable Railway company of Chicago has been incorporated; capital, $1,000,000.

Street Railway Statistics.—At a meeting held in Boston, Dec. 12, for the purpose of organizing a National Street Railway Association, Mr. Moody Merrill, of Boston, delivered an address, in which he said: "There are now organized and doing business in this country and Canada 415 street railways. These companies employ about 35,000 men and run 18,000 cars. More than 100,000 horses are in daily use to feed which it requires annually 150,000 tons of hay and 11,000,000 bushels of grain. These companies own and operate over 3,000 miles of track. The whole number of passengers carried annually is over 1,212,400,000. The amount of capital invested in these railways exceeds $150,000,000."

The N. P. C. Railroad.—From the Marin County *Journal*, of San Rafael, Cal., of Dec. 14, we clip the following: "The North Pacific Coast Railroad Extension Company is not letting the grass grow under its feet. The company is about letting contracts for the construction of its new line from Corte Madera Station to Saucelito, which includes much heavy work and a tunnel 2,100 ft. long. The specifications order that the work be completed by Sept. 1, 1883. The portions not contracted for will be built by the company, and the total estimated cost of the work will reach as high as $150,000. The new line will consist of light grades and easy curvature, and materially shorten the distance between San Rafael and San Francisco. Mr. George M. Dodge has been appointed Constructing Engineer, and is now busy getting the line ready for the graders."

Railroad Statistics for 1882.—The *Railway Age* of Chicago publishes a table showing that the number of miles of main track laid during the year of 1882 was 10,821, on 316 lines, in forty-four states and territories. Full returns will probably make the grand total 11,000 miles, which is 1,500 miles more than was constructed in 1881—the banner railroad building year up to that time. The number of miles constructed in the states mentioned below is as follows: Iowa, 958; Texas, 817; New York, 752; Ohio, 555; Arkansas, 529; Indiana, 525; Colorado, 500; Dakota Territory, 480; Pennsylvania, 464; and Minnesota, 444. Of the 316 roads noted, 140 are still uncompleted. The capital invested during the year is estimated at $270,000,000, exclusive of the amounts expended in the preparation of the road-beds on which tracks are not yet laid.

Troy, N. Y., December 28.—A survey has been completed for a railroad from Valatie, Columbia County, to the Hudson River, a distance of about five miles, connecting with the Hudson River Railroad.

CONTRACTS LET.

The Manly & Cooper Manufacturing Company, Elm avenue and Forty-second street, Pittsburgh, have secured the contract for the fire-proof shutters of the new United States Custom House and Post Office, Cincinnati, at $124,666.65.

BUILDING.

Vermont is said to produce more marble than any other state in the union or than any country except this. The business has expanded with marvelous rapidity since 1870, when comparative little Vermont marble was to be found in the market. The aggregate amount of the state's production the present year is 1,000,000 cubic feet, valued at over $2,000,000. The number of men employed in the quarries and mills exceeds 2,300, and it required 10,000 cars to carry the marble away. Nearly $1,000,000 was paid for the labor of working-men by the quarry owners.

Building Operations in Chicago.—The building operations during the past year were never exceeded, except in 1872, the year succeeding the great fire. Even then the amount of rebuilding was only twice as great as that of the past year, and the amount of ground covered by structures was less than twice as great. Building permits to the number of 5,630 have been issued; the frontage of new structures, lineal measure, is fourteen miles, and the cost of buildings erected on permits, $17,500,000. The total cost probably amounts to $20,000,000. Suburban towns show an equal growth and building prosperity, and the character of the edifices is generally improved.

The Bowling Green Building Company, of the city of New York, has been incorporated. Capital, $1,000,000. The object is to erect buildings in the city.

A glass spire is to be a feature of a new Presbyterian church in Philadelphia.

TRUSS BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

March 27, 1849, James Barnes, of Massachusetts, devised a truss bridge in which he united the two chords, the upper and lower, of an ordinary truss into one elliptical or oval curve, in which the tension of the lower portion of the curve, being transmitted along the curve to the upper portion is resisted by the opposing thrust of the latter.

Fig. 1 exhibits the form of the truss *C D E F G H* as constructed of iron. The elliptical curve is formed of parallel plates. Straining beams *K* of cast-iron are interposed between the parallel plates, and extend from post to post.

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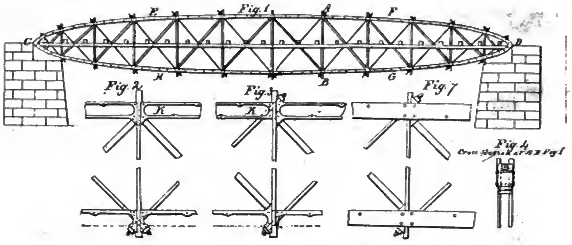
* Copyright, 1882.

The ends of the straining beams, where they abut against the post, are enlarged in order to form shoulders for the purpose of receiving the ends of diagonal cast-iron braces. The sustaining rods which form the interior frame work of the truss, are of wrought iron. By this mode of bracing the curved or elliptical form of the truss is preserved, and the several tensions and thrusts of the structure are properly transmitted.



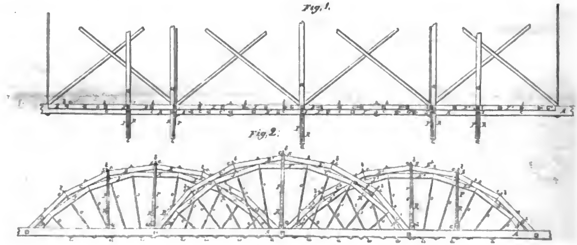
BARNES' BRIDGE.

It would seem that Barnes' construction is the first to provide a continuous curved chord, by means of which the thrusts and tensions are continued throughout the chord and made reciprocal.

April 23, 1850, Henry Lanergan, of Massachusetts, devised a novel truss bridge.

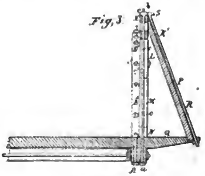
A is the main chord, *B* B^1 and B^2, etc., are separate series of straight timbers disposed together in a curve resting on the chord *A*. Under these timbers another series *H* H^1 H^2, etc., are arranged as seen in the drawings.

The several timbers of each arc are arranged in chords of the curve of the same, making a very obtuse angle with each other. Through their angle of junction, and the middle of the timber which lies directly above or below them, one of a series of suspension rods *o* is carried in a radial direction. These rods have heads *a*, screws *b*, and nuts *c*. Correction may be made for any sagging or settlement of the timbers by means of these suspension rods. Each arch is made to lap or extend by the one on one or both sides of it, or so that one or both of its feet shall rest upon the chord.



LANERGAN'S BRIDGE.

The suspension rods of nearly half of one arch are made to cross those of nearly half of another arch and to act in connection with them to support the chord *A*, thus ensuring to the beam a compensation for the thrust of the two arches. The thrust of one arch being in a direction opposite to that of the other causes the resultant or force sustaining the beam to operate in nearly a vertical direction. Each arch may be supported by one or more inclined timber struts *P* extending down from it and resting on a timber *Q*, bolted transversely upon and to the timber *A*. A tension rod *R* is also used, which passes through the timber *Q*, and downward from a metallic lap plate *S* on the top of the arch.



LANERGAN'S BRIDGE.

(TO BE CONTINUED.)

ENGINEERING NEWS.

Devoted to Public Works, Civil Engineering and Contracting.

VOL. IX., No. 1. NEW YORK, SATURDAY, JANUARY 7, 1882. PRICE 10 CENTS.

PROPOSALS.

ARCHITECT'S DESIGNS—St. Louis, Mo.—Competitive Designs for a Lutheran Seminary, proposed to be erected in St. Louis, Mo., at a cost not to exceed $85,000, will be received by the undersigned Committee up to noon of the 1st of March, 1882. Information and particulars as to the extent and character of the said designs can be obtained upon application to Rev. Otto Hanser, 1,811 Fulton street, St. Louis, Mo.

The following premiums are offered:

For the design most approved of	$300
For that approved of as second best	200
For that approved of as third best	100

The designs for which said premiums will be awarded are thereupon to become and be the property of the undersigned Committee. Right is reserved to reject any and all designs.

C. W. BEHRENS, Pres.
E. T. W. MEIER,
C. HEINTZ,
H. KALBFLEISCH,
DR. H. DUEMLING,
OTTO HANSER, Sec.
} Building Committee.

1-2t

SLATE MACHINERY WANTED.—Makers of machinery for slate working into tables, mantels, cisterns, etc., are requested to communicate, with prices of all tools requisite to fit up a first class mill, such as saws, planes, etc., with T. BACON, 30 St. Francis Xavier st., Montreal, Canada. 1-4t

Proposals for Dredging.

U. S. ENGINEER OFFICE,
NORFOLK, VA., Dec. 28, 1881.

PROPOSALS FOR DREDGING.—Sealed proposals in triplicate, will be received at this office until noon of Jan 27, 1882, and opened immediately thereafter, in the presence of bidders, for Dredging in Archer's Hope River, Virginia.

The right to reject any bid is reserved. Blank forms of proposals, specifications, etc., can be had on application to this office.

JAMES MERCUR,
1-3t Captain of Eng'rs, U. S. A.

SEALED PROPOSALS for building 100 coke ovens on Laurel Fork of Bluestone River in Tazewell County, Va., will be received until noon, Jan. 15, 1882. For blank forms, specifications and drawings, apply at the office of the South West Virginia Improvement Co., 37 South Third street, Philadelphia, or of the Superintendent of Works, Abbs Valley, Tazewell County, Va. Parties wishing to go to Abbs Valley can go to Lowell station, on Ches. & Ohio R. R., or to Dublin or Wytheville, on Norfolk & Western R. R., and thence by conveyance. The company reserve the right to reject any and all bids.

DREDGING.

TENDERS REQUIRED by the Colonial Government, Barbadoes, for ten years' dredging of the Inner Harbor to a depth of 17 feet.

Present average depth.....13¼ feet.
Area .... 5 1-30 acres.

Plan, specification and other information will be forwarded by the Superintendent of Public Works, Barbadoes, on receipt of P. O. order for fifteen shillings.

Tenders will be opened May 1, 1882.

WALTER HELY-HUTCHINSON,
Colonial Secretary.
BARBADOES, Nov. 12, 1881.

EDWARD PRINCE,
CONSULTING ENGINEER

For Water-Works and Levees.

Address, care American Society of Civil Engineers, N. Y. City, and after Sept. 1, Quincy, Ill.

J. JAMES R. CROES,

(MEMBER AM. SOCIETY CIVIL ENGINEERS),

CIVIL ENGINEER,

Water Supply, Drainage and Sewerage of Towns.

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QUINCY WATER-WORKS CO.
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HEART YELLOW PINE R. R. TIES,
7 ft.×7 ft.×8 in.,
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Are prepared to receive orders for coming season at REASONABLE PRICES.

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WANTED.—AN EXPERIENCED draftsman on iron bridge and roof work; one competent to take charge of the drafting department in a bridge building establishment. Address J. W. W., ENGINEERING NEWS office.

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Is now Chief Engineer of a nearly-completed system of water-works for a city of 40,000 inhabitants. Address, DELTA, this Office.

WANTED, by a graduate engineer, work of any kind. Have had considerable experience as a topographical draughtsman. Also experience at mining engineering. Situation as draughtsman preferred. Address KAPPA, this office. 1-2t.

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100 stone cutters, wages $3; also 100 quarrymen, wages $1.75, wanted on the New York, West Shore & Buffalo Railroad, at Haverstraw, N. Y., only 40 miles up the Hudson River from New York. This is the largest piece of mason work on the road. Long job.

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167 W. Springfield St., Boston, Mass.

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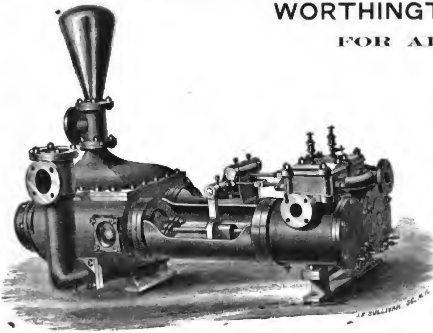
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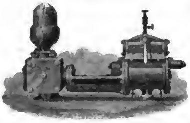

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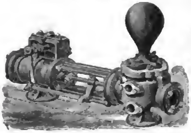

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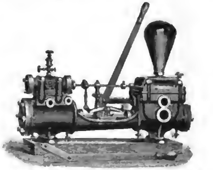
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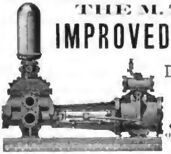

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Warranted to be the simplest and most efficient steam pump made,
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COMPOUND PUMPING ENGINES,
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True to pattern, sound and solid, superior in strength, toughness and durability to iron forgings, in any position, or for any service whatever. Gearing of all kinds, Shoes, Dies, Hammer-heads, Piston-heads, for Locomotives, Railroad and Machinery Castings of every description. 15,000 Crank Shafts and 10,000 Gear Wheels of the Steel now running prove its superiority over all other Steel Castings. CRANK SHAFTS AND GEARING SPECIALTIES. Circulars and Price Lists free. Address
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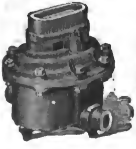

These meters are entirely different in principle, except that both are positive in measurement. 15,000 meters made by this company are in use in the United States and Canada with the most satisfactory results. Trial meters will be sent to any Water Company for tests. Catalogues, price-lists, etc., furnished on application. Also manufacturers of
WATER PRESSURE REGULATOR VALVES
for reducing and regulating (automatically) the pressure between a high and low service supply; very valuable where a reduction in head is required. Also, BALL'S IMPROVED FIRE HYDRANTS and improved method of tapping Water Pipe with bands, etc., and Fittings for General Hydraulic Work.

ASPHALTED WROUGHT-IRON PIPE COMPANY,
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Are now manufacturing WATER PIPES warranted to sustain an internal pressure of 300 lbs. to the square inch, and capable of resisting all external violence to which pipes for Water and Gas are ordinarily subjected.

The inside of these Pipes, remaining permanently smooth, increases the discharge one-third, and the water will always flow free from rust and other particles held in solution or suspense and without any discoloring or taste. The Asphalted Wrought-Iron Pipe is also well adapted for Gas. For Telegraph or Electric Light wires, it is coated with an extra heavy lining of Asphalt, making it a perfect insulator. It is impervious to air, moisture and decay, and, in fact, indestructible when under ground. The weight of these pipes being only about one-third of the corresponding sizes of cast-iron pipes, they can therefore be transported, handled and laid with more facility and less expense than any other pipe. Orders will receive prompt attention.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

TO OUR READERS.

We beg leave to call attention to the new "make-up" of ENGINEERING NEWS. The pages of reading matter and those of advertising have been made uniform in length; the paper has been changed to a larger size so as to insure a respectable margin for binding: the type will hereafter be all set solid, which, while it has not the brighter look of leaded matter, insures a gain of one-sixth of the whole composition; the readers will therefore gain more than a full page over the contents of each number of the last volume. The "General Intelligence," containing the passing news of each week, has been transferred to the advertising pages, leaving eight full pages of carefully selected matter for binding at the close of the volume. The items of general intelligence will each have a heading hereafter, and with the advertising pages can be indexed separately. By this arrangement we propose to give added value to our advertising pages, while at the same time we do not diminish the value of the reading matter to subscribers, but rather seek to enhance the permanent value of the completed volume. We are endeavoring to make a newspaper that will be of value to subscribers and advertisers. During the past two months we have added very largely to our expenditures, and in the present volume we intend to give to the classes who are interested in civil engineering construction the best *practical* newspaper *in the world*, no matter what the expense may be. Our first number cannot be expected to be up to standard, but we hope our efforts to please our patrons may be understood and appreciated by them. They have been very liberal in the past and we are very much obliged.

GAS AND WATER.

LOUISVILLE, Ky., Dec. 29, 1881.

CORRECTION.—*Editor Engineering News:* In your valuable paper of 24th inst. is a copy of an item going the rounds, of the rejection of the water-works built at Joliet, Ill., by Jesse W. Starr, Jr., of this city.

We know nothing of the facts, but desire you to make public that Mr. Starr is not from Louisville, Ky., but resides, and, we believe, has always resided and done business at Camden, N. J. The item that he is from here is a mistake. Very respectfully,

DENNIS LONG & CO.

INDIANAPOLIS WATER-WORKS.—Work on the extension has been temporarily suspended, on account of heavy freshets in White River, which flooded the site of the conduit and filter gallery, followed by a sharp frost. The new pumping machinery is under way at the Davidson Pump Works, in Brooklyn, and will be set up next month. The Water Company will then have the small Holly engine and the gang and rotary pumps for sale—the demand having outgrown their capacity. The Holly pumps put in in 1875, and the new steam pump and water pumps designed by Mr. Worthen, will have an aggregate capacity of 15,000,000 gallons daily.

COMPARATIVE WATER STATISTICS.—The following is a comparative statement of the cost of water in some twenty-two cities in Europe and America:

CITIES.	Population.	Annual gallons pumped	Annual amount collected from consumers.	Cost per 1,000 gallons.
Buffalo	164,000	5,063,080,343	$250,352.48	$3.50
Detroit	116,000	3,532,065,310	227,432.73	4.01
Chicago	503,000	21,002,081,866	865,818.35	4.12
Erie		775,803,250	37,495.00	4.84
Wilmington	44,000	1,394,737,290	68,404.23	5.24
Jersey City		5,445,007,020	299,578.95	5.50
Newark	136,400	3,425,013,348	183,500.16	5.36
Cleveland	156,000	3,725,063,021	202,377.02	5.43
Philadelphia	847,542	21,120,792,398	1,218,925.06	5.77
Troy	56,747	890,580,478	61,060.39	6.86
St. Louis	400,000	8,871,583,098	613,065.73	6.91
Cincinnati	290,000	7,128,466,425	499,857.36	7.01
Boston	412,000	9,684,395,710	995,010.31	10.30
Pawtucket	30,000	375,000,000	45,000.00	12.00
Lowell	60,000	860,000,000	125,000.00	14.53
Lynn	38,284	458,567,800	79,868.92	17.42
Fall River	48,000	406,432,404	114,706.38	23.10
Hull, England	153,000	1,712,050,145	129,430.92	7.50
Liverpool, "	747,825	6,071,004,545	942,358.80	15.52
Berlin, Germany	962,478	5,045,550,801	724,082.57	14.35
Dresden, "	219,000	1,422,030,720	115,704.08	8.13
Hamburg, "	306,871	7,270,771,515	290,224.30	3.99

HYDE PARK (ILL.) WATER-WORKS.—The contract for the completion of the tunnel to the Hyde Park Water-Works has been let to Robinson & Minor, the contractors for the shaft and first sections of the work. The trustees, at a recent meeting, adopted the ordinance for the improvement of Ninety-fifth street, from Commercial avenue to State street. The estimated cost was $39,782. The ordinance for the main sewer to be laid in Forty-fifth street, from Grand boulevard to the lake, was passed. The estimated cost was reported to be $19,104. Special assessments were ordered in both of these improvements. The attorney was directed to bring up the assessment-roll for the Fifty-sixth street sewer in the county court, and apply for judgment. The work on the Prairie avenue sewer has been delayed beyond the terms of the contract, which, on motion, was declared forfeited. The attorney presented a contract and bond for the construction of the water-works tunnel, which had been awarded to the same contractors who had the Prairie avenue sewer. A motion was made that the office of chief engineer at the water works be abolished, but no action was taken on the subject. In this connection a communication from the town of Lake was read, which stated that W. W. Sprague had been appointed chief engineer of the town of Lake water-works, to act as chief engineer of the joint water-works until the separation of the two works.

DALLAS WATER-WORKS.—The city of Dallas takes charge of the water-works this week. One hundred thousand dollars of Dallas City Water-Works bonds have been signed by the mayor and city secretary, and forwarded to the comptroller at Austin for registration. These bonds were returned by the first of January, and will be ready for negotiation and for paying for the water-works.

TOWN OF LAKE, Cook Co., Ill.—During the past year the progress of public improvements in this town has been marked. Over 25,530 feet of sewerage have been built at an average cost of $4.70 per foot, the diameter ranging between twelve and sixty inches. Of water mains, 26,000 feet have been laid, the cost per foot varying from 70 cents to $2.50. The size of the mains is between four and twelve inches. In addition to the above 9,100 feet of twenty-four-inch mains, for general supply, have been laid at an average cost of $6.63 per lineal foot, and 1,700 feet of thirty-inch suction pipe from the works to the crib, at a cost of $10 per foot, under the supervision of J. F. Foster, chief engineer and superintendent, by the town, the lowest contract price bid being $14 per foot. The town now receives its supply of water through this suction-pipe, the increased pressure being nearly forty pounds. About $30,000 has been expended upon roads and bridges, and nearly $60,000 on the new pumping machinery at the water-works. This new machinery is arriving daily and being rapidly placed in position. Those in charge of the work claim to be able to furnish the town with 15,000,000 gallons of water every twenty-four hours, if required, and to show a fire pressure of seventy pounds to the square inch in any part of the town.

MILWAUKEE WATER-WORKS.—During 1881 the people of Milwaukee consumed 4,855,021,486 gallons of water, and 4,686,969 tons of coal were used in pumping the same, or about a ton for every 1,000 gallons.

CHICAGO WATER RECEIPTS.—The receipts for the water department last year were $984,218.19, against $865,616.36 last year, an increase of $118,601.84.

WATER FOR ORANGE, N. J.—The joint committee appointed to take steps to secure a water supply for the Oranges, N. J., have agreed upon a report. The committee is of the opinion that if the people decide to vote for water at a special election to be called for that purpose, the works can be put into full operation before the summer of this year has passed. A sufficient supply can be had for $150,000. It seems to have been agreed that the water shall be taken from the mountains, two sources being under consideration. One of these is near Llewellyn Park, and the other on the top of the mountains. A well is to be sunk at one of these points with a capacity of 500,000 gallons, and a stand-pipe erected with a capacity of 250,000 gallons. Then there are to be two engines capable of pumping 500,000 gallons daily. The stand-pipe, which is to be supported by a foundation of brick and stone, is to be 75 feet high and 25 feet in diameter, and it is proposed to give a pressure of 125 feet head for the average height in Orange and 50 feet head for the highest point within the city limits. Ten miles of piping will be first laid and there will be 100 fire hydrants. It was at first suggested that the Rahway River be the source of supply, but the drawing of the water thence would necessitate the purchase, at large cost, of extensive mill rights along the stream.

ELECTRICITY.

FOND DU LAC ELECTRIC TOWERS.—The Elgin (Ill.) Tubular Iron Company will furnish the city of Fond du Lac with four towers to illumine the city with electric light.

UNDERGROUND TELEGRAPH AND TELEPHONE WIRES.—The wires of the National Underground Electric Company, Philadelphia, from the public buildings to the Delaware River, were tested on the 3d, and the successful character of the test, it is believed, will induce the city council to adopt the underground wire for lighting the city in preference to the present system, which will undoubtedly be discarded. The alarm in that city over a fire produced by electric wires will probably result in a renewed effort to bring the millions of yards of telegraphic, telephonic and electrical wires now there under ground. Boston, also, has authorized the construction of continuous lines of pipes by private enterprise in a large number of streets, on condition that all telegraph and telephone companies be allowed to hire reasonable space in the pipes at a rental not exceeding the cost of maintaining the wires overhead. In New York one underground wire enterprise has been vetoed by the Mayor, partly for the reason that the streets indicated were already too full of sewer, water and gas pipes to give room. It is evident that the time has come for studying and utilizing the whole subsoil of New York. On some definite plan, the entire underground street and park accommodations of the city should be so catacombed that whether for pipes, sunken railroads, or other purposes, they can be had on proper and impartial terms, and in such a way as to relieve the streets of the masts, cross-pieces, wires, railways and other obstructions which now help to take away from many narrow streets their sunlight and air, or clog the free passage of the people and disfigure the thoroughfare.

STREETS, DRAINAGE, ETC.

LIGONIER PAVEMENT.—This new pavement has been adopted for Larimer avenue, Pittsburgh.

MACADAM.—Council Bluffs, Ia., is going to macadamize one of its principal business streets, and the city engineer has been authorized to advertise for bids.

TUNNEL CONTRACT AWARDED.—The Board of Public Works, of Milwaukee, on the 29th ult., awarded Henry Buestrin the contract for constructing the tunnel under the Menominee River, to be used in connection with the intercepting sewers, for $20,500. The tunnel will be 650 feet in length.

BUFFALO SEWERS.—Buffalo is clamoring for an improved system of sewage.

BRIDGES.

WASHED AWAY.—A freshet in the Tye River, on the 27th ult., washed away several yards of the Richmond & Alleghany Railroad bridge, about one hundred miles from Richmond, Va.

THE NEW MINNEAPOLIS BRIDGE.—Darragh, Haviland & Company, of Painesville, have been awarded the contract with the St. Paul, Minneapolis & Manitoba Railway Company, for building a viaduct over the Mississippi River, at Minneapolis. Mr. Darragh says it will require the labor of about 1,000 men for two years to complete the work, and that its cost will be over a million dollars. It will consist of nineteen arches, the spans ranging from eighty to ninety-eight feet in width, and to be constructed for a double track. A large portion of the masonry will be built of granite. Mr. Darragh will commence the work at once. Col. C. A. Campbell, who has had charge of the masonry work of the bridges at Painesville and Westfield for the New York, Chicago & St. Louis Railway, will accompany Mr. Darragh to take charge of the masonry work on the viaduct.

THE ALBANY AND GREENBUSH BRIDGE COMPANY has taken up the two mortgages, one given in 1875 and the other in 1880, to cover bonds to construct the bridge, and has given a new mortgage to the Mercantile Trust Company of New York, to secure bonds to the amount of $900,000, in denominations of $1,000, each payable on November 1, 1891, in gold coin, with interest at the rate of six per cent. per annum, also payable in gold.

WASHED AWAY.—Many bridges have been washed away by a freshet in the White River, Indiana.

HARD UP.—The Wabash Company denies that it is in straits for money, but the charge is renewed that owing to the St. Charles bridge loss the company will pay no cash dividend for a year to come and the company virtually admits that no dividend will be declared on the preferred stock next month.

THE ST. CHARLES BRIDGE.—D. J. Whittemore, chief engineer of the Chicago, Milwaukee & St. Paul Railroad; L. H. Clarke, chief engineer of the Lake Shore Railroad; A. Gottlieb, President of the Keystone Bridge Company; W. S. Pope, President of the Detroit Bridge Company, at the invitation of the officers of the Wabash, St. Louis & Pacific Railroad Company, are a commission to consult with Col. C. Shaler Smith, and decide what kind of spans shall take the place of the one that recently fell out of the St. Charles bridge and the remaining one of the same structure that did not fail. They have made a thorough examination of the bridge and its approaches to determine what is to be done to make the structure safe and permanent beyond any question. The purpose of the management of the railroad is to erect a bridge that will bear the most critical examination in its every part, and in selecting the gentlemen above named, who are among the best engineers in the country, conversant with bridge building, to decide what kind of structure should be put up, they feel that the object they have in view will be fully secured. The report of the Commission has been sent to New York for approval at headquarters.

RAILROADS.

CONSOLIDATION.—The Joliet & Indiana and the Laporte & Indiana railroad companies were consolidated on the 3d inst. under the name of the Joliet, Indiana & Western Railroad Company, with a capital stock of $1,000,000.

MEXICAN RAILWAYS.—The Mexican government, on the report of its engineers that the road has been built according to the concession granted the company, has allowed the Mexican National Railroad Company to open thirty miles of road just completed from Rio Grande south.

NORTHEASTERN RAILROAD.—The construction of the Northeastern Line of the Erlanger system will be pushed forward very rapidly, as the contracts provide that the road must be completed within twelve months, including the bridge across Lake Pontchartrain. The company has purchased property—ten squares with a river front—in the Third District of New Orleans, known as the Levee Steam Cotton Press, for a depot, etc. The price paid was $390,000.

ANOTHER CHICAGO RAILROAD.—The Danville, Olney & Ohio River Railroad has effected an entrance to Chicago over the tracks of the Chicago & Eastern Illinois Railroad.

A THIRD ROUTE ACROSS THE CONTINENT.—The connection of the Texas & Pacific with the Southern Pacific Railway at El Paso has been made, giving the third distinct route across the continent. The line was formally opened for through traffic on Sunday morning, Jan. 1, when the first passenger train left St. Louis for San Francisco.

SOUTHEASTERN ROAD.—Large quantities of railroad material are accumulated at Belton for the extension of the Santa Fe to Lampasas. Railroad camps are thick from a mile below town to the end of the grade. Workmen are now gathering at the Lampasas River, preparatory to commencing work on the railroad bridge.—*Lampasas Dispatch.*

CHICAGO CITY RAILROAD STOCKS.—These stocks are quoted at 210 asked for North Division City Railway, 315 asked for West Division Railway, 310 asked for South Division Railway.

St. Gothard Tunnel.—The trial trip through the St. Gothard tunnel was highly successful. The time occupied in the passage of the train was fifty minutes one way and thirty-three the other way.

RIVERS AND HARBORS.

Damming the Upper Mississippi.—The United States engineers have received instructions to begin work on the proposed dam at the outlet of Lake Winnebagosish immediately. Appropriations for the work were made by Congress during the last session and the one preceding, the whole amount being $250,000. The dam is to rise to a height of about fourteen feet above the low-water level of the lake. This winter will be consumed in getting out timber and other material for construction, and in transporting men, supplies, tools and machinery to the ground. Actual construction will commence as soon as the ice moves in the spring and be carried forward rapidly. Mr. Charles Wanzer has been assigned by Maj. Allen to the immediate charge of operations, and with a party of twelve men has already departed for the lake with the lengthy name.

LABOR AND SUPPLIES.

Puddlers' Strike.—There is a prospect of a general strike by the puddlers in the various rolling-mills in the middle district of Pennsylvania, extending along the Susquehanna River for nearly 50 miles, unless their employers advance the wages as demanded by the puddlers, who are now receiving $4.50 per ton. The increase asked is 50 cents. The demand for higher wages is based on the steady improvement of the iron trade, which, the puddlers say, was never in better condition in the State, the supply being inadequate to meet the demand. All the employés of the Lochiel iron-Works, an extensive establishment, are on a strike for more pay, and those of Bailey's rolling-mill, in Harrisburg, have informed their employers that if they refuse to grant their request they will strike in two weeks.

Wages Paid for Digging Coal.—Latrobe, Pa., 40 cents per 2,000 lbs.; Lingo, Mo., 5 cents per bushel; Kittaning, Pa., 55 cents per 2,240 lbs.; Myersdale, Pa., 40 cents per 2,000 lbs.; Clearfield, Pa., 50 cents per 2,000 lbs.; Georges Creek, Md., 65 cents per 2,240 lbs.; Bevier, Mo., 5 cents per bushel; Richmond, Mo., 6 cents per bushel; Washington, Pa., 3 cents per bushel; Monangahela region, 4 cents per bushel.—*Coal Trade Journal.*

Boston, December, 1881.—The undersigned, with an experience of over eight years in the testing and inspection of cements, respectfully offers his services to those who may require them. The testing of Portland cements a specialty. Wm. J. Condon, 74 Tremont street, room 15. References: Henry M. Wightman, City Engineer, of Boston; Eliot C. Clarke, Prin. Asst. Imp. Sewerage, of Boston.

Cement.—The present market price of Saylor's Portland cement in lots of 100 bbls. to smaller quantities is $2.40 f. o. b., to $2.65, and cartage. Office is at 93 Liberty street, N. Y. City.

LEGAL.

Important Decision.—Decisions of the New York Supreme Court, General Term, just handed down at Syracuse, dispose of several important litigations. One is that of Charles A. Danolds, respondent, against the State of New York. The State authorities awarded Danolds a contract to build an addition to the State Reformatory in Elmira. That contract was canceled by the State before the work was performed, and the contractor sued before the State Board of Audit to recover damages therefor. The Board allowed him $65,000. Deputy Attorney-General Ruggles appealed, and the General Term has affirmed the award, with costs against the State.

Attempted Bribery.—Buffalo, N. Y., Dec. 30.—A terrific stench has been created by the discovery of an attempt to bribe certain aldermen with $1,000 each to rush through the intercepting sewer job at the last session of the Common Council of 1881, in the interest of a contracting ring. The sewer is to abate the notorious Hamburg Canal nuisance, and the cost will be from $1,500,000 to $2,000,000. It looks very much as if the case will go to the Grand Jury, and a number of prominent contractors and politicians may get into a heap of trouble.

NEW PROJECTS.

The American Quick Transit S. S. Co.—This company, which hopes to revolutionize the ocean-carrying trade of the world by building domed steamships which will cross the Atlantic in less than a week, was chartered in Boston on the last day of the year just gone. Capital, $2,000,000, all taken. President, Thomas Davis.

Dead.—The St. Louis, Texas & Gulf of Mexico Railroad, projected from Marshall to Sabine Pass, it is said, has died a natural death, and parties holding claims against it are running attachments for all property to be found to secure themselves.

New Railway Through Southern Pennsylvania.—Commencing at Wheeling, West Va., the coal road extends in a southerly direction to Waynesburg, the county seat of Green County; then runs directly east to Uniontown, Fayette County; then curves northeast to Connellsville, where it is intersected by a new road running down from Pittsburgh; it then passes on to the Laurel Hill mountain, which it crosses in Somerset County, near the Westmoreland County line, and strikes Somerset; then it proceeds to Berlin, and thence passes through Dester's Gap and follows the Raystown & Pennsylvania road to Wolfsburg, this county.—*Bedford Gazette.*

A New Texas Railway Enterprise.—Articles of incorporation have been prepared and charters will be secured within the next two weeks for another gigantic railroad enterprise in Texas, to be known as the Gulf & Pacific road, to run from New Orleans via Dallas to Isleta, near Albuquerque, New Mexico, and form a junction with the Atlantic & Pacific. It will run from New Orleans to Sabine River via Opelousas, a distance of 220 miles; then to Dallas per the Texas Trunk, absorbing that road, a distance of 250 miles; thence northwesterly to the boundary of the State, in Bayley County, a distance of 400 miles; thence via Fort Sumner to Isleta, in the valley of the Rio Grande. The entire length of the road will be 1,130 miles. The road will be in three separate divisions, the Louisiana, the Texas and the New Mexico, and there will be three separate boards of directors. It is proposed to capitalize at the rate of $15,000 per mile, making the stock $16,950,000, and bonds at the same rate will be issued. The road will be operated by three different companies, incorporated under the laws of Louisiana, Texas and New Mexico. It will be built by a construction company formed under the laws of New Jersey. The road is backed by some of the strongest banks and capitalists of New York, Philadelphia, Boston, and Washington, as well as Europe. It is intended to make Gen. D. E. Sickles, identified with Paris capitalists, President and ex-Governor Throckmorton, of Texas, Vice-President. James G. Blaine, ex-Speaker Randall and his brother Robert, the Seligmans of New York, the Nickersons, of Boston, and others of national reputation are interested in the project.

Elevator Company.—The Superior City Elevator Company, St. Paul, Minn., was incorporated on the 31st ult. Capital $250,000.

Locating Party.—The surveying corps of the Gulf, Colorado & Santa Fe Railway Company, under Major Banks, were about 20 miles south of Abeline, Tex., on the 30th ult.

New Drill Co.—The Reutchler Drill Company, of Belleville, Ill., capital stock, $25,000; incorporators, Henry Reutchler, George A. Wiley, and J. D. Reutchler.

New City Hall.—It has been voted to expend $150,000 for a new city hall at Indianapolis, the hall to seat 3,000 persons.

The Austin Capitol.—The new capitol building at Austin, Tex., is to be 866 feet high, 566 long, and 286 in depth, the seventh highest building in the world, and the second in the United States.

New Smelting Process.—The Eureka Smelting Company has been incorporated at Elkhart, Ind., with a capital stock of $2,000,000, to test, on a large scale, an invention by a Mr. Bressler, by which he claims to be able to extract all the precious metals from the most rebellious ore.

New Companies.—Charters have been filed at Austin, Tex., for the Decatur Street Car Company, capital stock, $20,000; the Austin & Central Texas Coal Company, capital stock, $250,000; President, Francis B. Forster; Vice-President and General Manager, R. B. Swancourt; Secretary and Treasurer, Austin M. Robinson. The Texas Tie & Timber Preserving Company, capital stock, $100,000; for the purpose of preserving, by chemical and mechanical process, timber, lumber and railway ties, according to the patent of Hugh E. Krinter, of Dallas. Dallas is given as the principal office of this company. The directory consists of Hugh E. Krinter, James B. Simpson, William H. Flippen and John F. Elliott.

The Texas & St. Louis Railroad.—The surveying corps of the Texas & St. Louis Railroad reached Greenville, Tex., on the 28th ult., from Dallas, and will proceed at once with the survey to Sulphur Springs.

The Cincinnati & St. Louis Air Line Railroad Company has been incorporated with a capital stock of $2,900,000. It is proposed to construct a line of road from East St. Louis to the Wabash River, at or near Palestine. Also, a branch, commencing in Effingham, running northwesterly to a junction with the Toledo, Burlington & St. Louis Railroad at or near Holliday, in Shelby County.

Southeastern Railroad Gossip.—Our mail from the City of Mexico brings us, in the *Two Republics*, some points of interest concerning Mr. Huntington's Mexican project. The Chamber of Deputies has approved the modifications made to the contract entered into between the Executive and General John B. Frisbie, last June, for the construction of a railroad from the Rio Grande to the City of Mexico and to the Pacific. The route is not yet fully determined. Two routes have been surveyed by Maj. R. B. Gorsuch, the chief engineer of the road, and one of these will be followed. One runs from Piedras Negras through Monclova, Saltillo and San Luis Potosi to Mexico; the other goes from Piedras Negras through the rich Laguna and Nazas country to San Luis. The branch to the Pacific may leave the main line at any point on it, and the company will also be permitted to build a branch to the Gulf of Mexico. If the first route is followed, it seems as though the road would almost parallel the Palmer-Sullivan narrow gauge between Saltillo and San Luis, unless the latter's route has been changed. If the Nazas line is taken, the Huntington road must probably go to or near Durango, where it will strike the Central road. The Department of Public Works has directed its inspector of the Central line to report whether or not it is in a condition to be opened to the public as far as San Juan del Rio, 191 kilometers (118¾ miles) from Mexico. It is stated that the Central will be completed to Queretaro by May 1. More than 1,000 men are employed in widening the cut through the Nochistongo Pass, doubtless to obviate the possibility of land slides. A California company proposes to construct an interoceanic railroad across the republic of Guatemala. It also contemplates a connection with General Grant's Mexican Southern, at Dolores. A railway is to be built in Mexico between Tlaxcala and Santa Anna. The different lines from Vera Cruz, via Mexico to Acapulco, for which concessions have been granted, have been consolidated under the presidency of Mr. Prida.—*New Orleans Picayune.*

The work of construction on the Central Railroad in the state of Queretaro is delayed by the scarcity of cross-ties.

The *Laderense*, a paper published in New Laredo, says that the Palmer & Sullivan company is terribly affected with provisionality. The name Mexican National is provisional. The bridge over the Rio Grande is provisional. The stations are provisional and the grading is provisional.

Regular trains have commenced running between the City of Mexico, and Cuantla, Morelos.

The value of railroad property in Texas is estimated at $150,000,000. Over 1,400 miles of railroad have been built in Texas within the last twelve months.

Engineer Cresy, with his Italian force, is now making the fills at the crossing of the Garcitas, and with the exception of about 1 mile the construction of the New York, Texas and Mexican road has about 12 miles ready for ties and rails from this city eastward.

Track-laying will begin in earnest in a few days between this point and Fort Worth, and before the 1st of March we confidently expect to hear the snort of the iron horse at our own doors. Work on the railroad has progressed rapidly of late. The grading between here and Fort Worth is nearly completed, and Mr. Morgan Jones has moved his forces north of Decatur and will soon have 25 miles north of here ready for the iron.

The Southern Pacific is now completed 40 miles east of its junction with the Texas and Pacific, and is building 2 miles a day toward San Antonio.—*El Paso Times.*

James A. Marlin, locating engineer of the Little Rock, Mississippi River & Texas Railroad, has located that road through to the State line in the north part of Texarkana, and expects the grading to be pushed to that point soon.—*Galveston News.*

CONTRACTING, MISCELLANEOUS, ETC.

The Trinity & Sabine (Texas) Railway.—Work on this road from Trinity Station, on the International, has been greatly delayed through want of men and material. One hundred and twenty teams and nearly 400 men are engaged on grading. The contractors say they will have grading from Trinity to Homer finished by June 1 next.

Steel Rails on the Sunset Railroad.—Between Houston, Texas, and Columbus, 86 miles, the old iron of the Sunset Railway has been replaced with steel rails except 8 miles, which will be replaced as soon as workmen can do it.

Line Located.—The engineer corps of the Sunset road have returned to San Antonio to report the location of the extension of the Columbus-LaGrange Branch from LaGrange to Bastrop, a distance of 42 miles, finished.

Little Falls & Dakota Railroad.—Col. Fish, chief engineer, has completed the final survey and location of this road through to Little Falls. There is considerable heavy work to be done in grading, and there is already a large number of men at work throwing dirt, and more will be located as soon as possible. The line is about 37 miles long.

Tie Contract.—Messrs. John D. Lyle, of Indianapolis, and Horace Scott, of Louisville, of the firm of John D. Lyle & Co., were in Sauk Centre, Minn., last week, looking after their immense tie contract.

Business.—Culdrum, Minn., is now enjoying her share of railroad excitement; surveyors, contractors, tie-makers and business men are the make up.

New Court-house.—Fond du Lac, Wis., has advertised for plans for a $55,000 court-house.

Brooklyn Sewers.—Bids for cleaning the sewers and street basins in 1882 ranged from $8,500 to $20,000; the contract was awarded to Bernard Makin at $11,000.

Stone Contract.—The following bids were received for the Soldiers' and Sailors' Monument at Buffalo, N. Y.:

Mitchell Granite Company	$48,500
Samuel Kitson, New York	47,000
New England Granite Company:	
No. 1. Westerly granite, Rhode Island	46,700
No. 2. Quincy granite, Massachusetts	45,000
No. 3. Oak Hill granite, Maine	43,000
No. 4. Waterford granite, Connecticut	41,000
Hinsdale Doyle Granite Company	46,255
Mount Waldo Granite Works	45,945

Government Contract.—At St. Louis, Mo., the contract for the iron door and window frames and the iron wainscot for the new custom-house has been awarded to Messrs. Bartlett, Hayward & Co., of Baltimore, for $60,165.

A City Without Credit.—Halifax, N. S., Dec. 30.—A crisis has been reached in the city's financial affairs, which have been in bad shape for some time. The Halifax bank stopped the city's credit, and the council meet to-morrow to consider how $21,000 coupons, maturing next week, are to be paid.—*Chicago Times.*

New Opera-house.—Dallas, Texas, is to have a new opera-house. Plans are being drawn.

Grading on the Texas & St. Louis N. G.—Robert Johnson, contractor, passed through Texarkana on the 29th ult., with twenty teams from Mount Pleasant, Texas, en route to Pine Bluff, Ark., to begin work on the Texas & St. Louis Narrow Gauge Railroad.

Broken Dam.—A dam at East Greenwich, R. I., broke away on the night of the 1st inst. Loss, $20,000.

The Chicago "Crib."—The contract was awarded to James S. Dunham for the use of a tug to ply between the shore and the crib this winter, the consideration being 1 cent for keeping the boat in readiness and $2.90 per hour for actual use.

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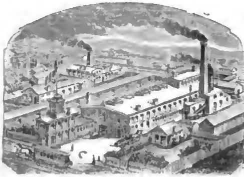

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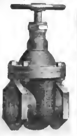

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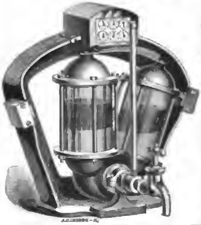

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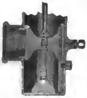

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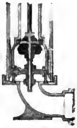

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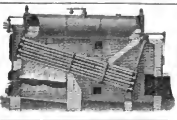

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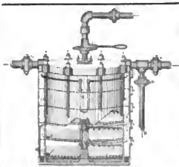

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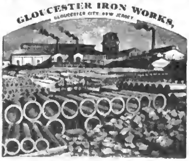

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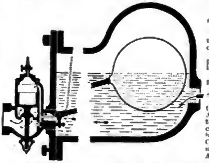

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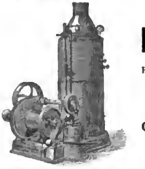

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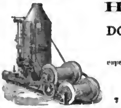

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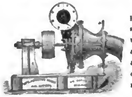

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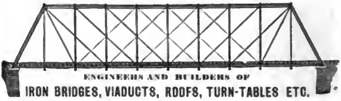

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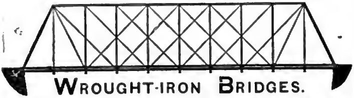

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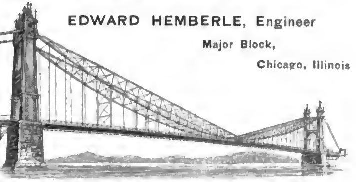

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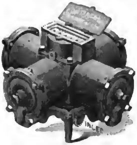

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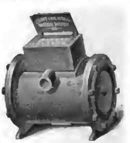

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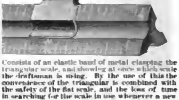

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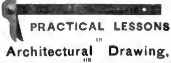

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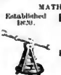

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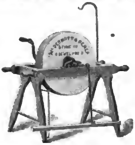

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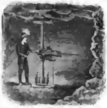

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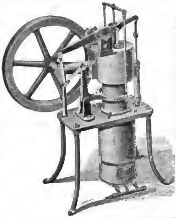

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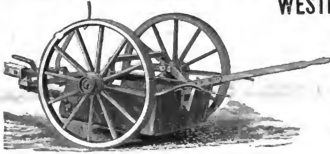

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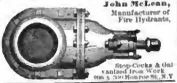

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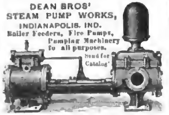

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Vol. IX., No. 5. NEW YORK, SATURDAY, FEBRUARY 4, 1882. Price 10 cents.

PROPOSALS.

Notice to Bridge Builders.

THE TOWN COUNCIL of Cumberland, Rhode Island, hereby invites proposals from bridge builders to furnish complete, in place on abutments, an iron bridge.

The trusses are to be one hundred and seven (107) feet long between centers of end posts, and are to be placed twenty-one (21) feet apart centers, with six (6) feet sidewalks on each side, furnished with substantial railings of wrought iron. The bridge is calculated to carry, with a factor of safety of five (5), one hundred pounds per square foot of floor surface, including sidewalks, additional to deadweight of structure; floor to carry wheel load of 4,000 pounds.

The bridge is to be located at Valley Falls, R. I., over the Providence & Worcester Railroad, 18 feet above grade of said railroad. Each bid must be accompanied by full plans and specifications of bridge, with gross amount proposed for bridge in place.

Bids will be received by the undersigned on or before March 6, 1882.

The right is hereby reserved to reject any or all bids.

ANDREW J. CURRIER,
For the Committee,
4-4t Valley Falls, R. I.

To Bridge Builders.

SEALED PROPOSALS will be received by the Directors of the Newport and Covington Bridge Company at their office in Newport, Kentucky, until noon of March 10, 1882, at which time the proposals will be publicly opened and read, for the erection of a suspension bridge over the river Licking, between the cities of Newport and Covington, and for alterations of the existing towers and masonry. The bridge is to be erected on the piers and abutments of the present suspension bridge.

The distance between the abutments is eight hundred and thirty-six feet eight inches (836 ft. 8 in.), and the bridge will be in two (2) spans.

Width of roadway, eighteen feet (18) with two sidewalks each six feet (6) wide.

Drawings may be seen and specifications, form of proposal and contract obtained, at the office of Anderson & Hobby, Civil Engineers, 68 and 69 Johnston's Buildings, Cincinnati, Ohio.

Proposals must be made on the printed forms only. Security to the amount of $50,000 will be required for the proper completion of the work.

The right to reject any or all proposals is reserved.

By order of the Board of Directors.
R. A. McDANNOLD, President.
L. R. HAWTHORN, Secretary. 4-6t

To Bridge Builders.

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The bridge is to be erected on the piers and abutments of the present suspension bridge.

The distance between the abutments is eight hundred and thirty-six feet and eight inches (836' 8"), and the bridge will be in four (4) spans.

Width of roadway, eighteen feet (18'), with two (2) sidewalks, each six feet (6') wide.

Bidders will be be required to furnish their own designs.

General specifications, form of proposal and contract, may be obtained at the office of Anderson & Hobby, Civil Engineers, 68 and 69 Johnston Buildings, Cincinnati, O. Proposals must be made on the printed forms only. Security to the amount of $50 000 will be required for the proper completion of the work.

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(Proposals Continued on Page X.)

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The writer has been twenty years in active professional practice. Among many responsible positions he has held the following: P. Asst. Engineer U. S. Navy; Inspecting and Superintending Engineer for construction and erection of the St. Louis Bridge; Superintendent Delaware Bridge Co.; Asst. General Manager and Superintendent Keystone Bridge Co.; Consulting Engineer for New York and Metropolitan Elevated Railroads, etc.

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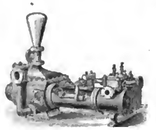

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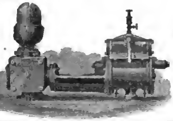

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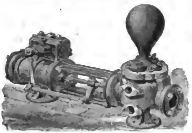

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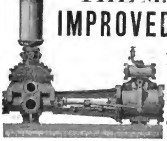

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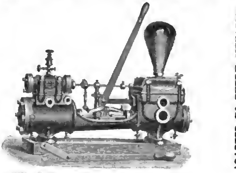

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The inside of these Pipes, remaining permanently smooth, increases the discharge one-third, and the water will always flow free from rust and other particles held in solution or suspense and without any discoloring or taste. The Asphalted Wrought Iron Pipe is also well adapted for Gas. For Telegraph or Electric Light wires, it is coated with an extra heavy lining of Asphalt, making it a perfect insulator. It is impervious to air, moisture and decay, and, in fact, indestructible when under ground. The weight of these pipes being only about one-third of the corresponding sizes of cast-iron pipes, they can therefore be transported, handled and laid with more facility and less expense than any othe pipe. Orders will receive prompt attention.

EDDY VALVES. FIRE HYDRANTS.
MOHAWK & HUDSON
Manufacturing Company.
WATERFORD, N. Y.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Newport to Get Gas from Cincinnati.—The directors of the gas company, Cincinnati, held a meeting at which they entered into a contract with certain parties to furnish gas to the city of Newport for the next twenty-five years at the following rates: First five years, 90 cents per 1,000 feet; second five years, 80 cents per 1,000 feet. For the remaining fifteen years the rate is thought to be 75 cents per 1,000 feet. The gas will pass through one meter in Newport, and be distributed from there through the city.

Water-works Damaged by High Winds.—Silver Cliff's (Col.) water-works have been damaged about $1,000 by high winds.

Cost of Water-works.—The water-works at Glendive cost the Northern Pacific Company $12,000.

New Water Company Organized.—Washington, Pa., has organized a new water company.

Proposals for Gas or Electricity.—The custodian of the U. S. Custom house at Chicago invites proposals until April 1 next for lighting, by gas or electricity, the Custom-house building in Chicago.

City Works Department (Brooklyn) for 1881.—According to the last report the water revenue was as follows:

Regular rates....	$616,791.08	$586,666.22	$30,124.86
Extra rates....	352,761.08	324,449.81	28,311.27
Defaults.	8,151.14	5,929.43	2,221.71
Total..	$977,703.30	$918,045.46	$60,657.84

While the actual amounts received in 1881, as compared with the receipts of 1880, show a decrease of $60,657.84, the fact must be taken into consideration that the rates were reduced during the year to an amount exceeding $85,000, which shows that the revenue from water is continually increasing.

The total amount paid for maintaining the works during the year was $814,431.19, an increase of $42,110.12 over 1880. The cost of lighting, extinguishing, cleaning and repairing the street lamps was $324,123.90; of cleaning the streets and removing ashes, $70,600.49; of repairing streets with cobble-stones, $62,652.62; of constructing sewers (solely the Bond street sewer extension), $64,650.50.

The working force of the department in all its bureaus and branches during the past year bears a favorable comparison as to expenditures with former years, and shows a heavy reduction in the amounts paid for salaries and labor, as follows:

1874	$488,210.81
1875	321,674.90
1876	481,223.90
1877	400,802.73
1878	428,704.98
1879	342,776.37
1880	333,340.88
1881	319,102.61

In regard to meters the report says: "The results thus far obtained by the setting of meters have fully justified the measure. The benefits have been two-fold; first, in a largely increased revenue from eating-houses, liquor saloons, etc., heretofore rated at from $5 to $30 each, and from stables where horses and cows were formerly rated so much a head per annum; and, second, in an immense decrease of the heretofore enormous waste of water in this class of establishments. In my opinion the interest of the city cannot be properly guarded without even a more general use of meters, as by this means alone can that large portion of our citizens who recklessly or wantonly waste this element, for which they inadequately pay, be brought to a sense of their responsibility through a draught upon their purses for extra water consumed or wasted."

Light Appropriation for Boston.—The committee on lamps at Boston recommends the appropriation of $436,042, being $5,442 more than was asked last year. The sum of $79,870 is required for 100 lights each of the Brush, American and Western electric companies, a contract having already been made with the first company.

Jersey City Water-Works.—In order to stop the pollution of the Jersey City and Newark water supply, a bill has been presented to the legislature for permission to dam the Passaic River at the Belleville Pumping Works.

San Antonio (Texas) Water-Works.—The Water-works Committee made a report proposing that the Water-works company lay 26,000 additional feet of piping, and that the city take sixty additional fire plugs at $50 per annum each. A minority report was made that the city propose to purchase the water-works, and should the company refuse to sell that a proposition be submitted to a vote of the people for the establishment of new water-works. Consideration of these reports was postponed till next meeting.

The Las Vegas (N. M.) Water-Works.—Water has been turned on in the water-works just completed for the above city. They were found to be in perfect order and condition. The water is brought to town in pipes a distance of seven miles from the mountains above the Hot Springs, where a reservoir has been made. The works were constructed by Messrs. Russell & Alexander, of Colorado Springs, at a cost of $190,000. The money was raised by a stock company, and was largely subscribed by citizens of this county. The pressure of water in the pipes is very great, and will throw the water above the highest buildings in the city, thus providing the very best protection against fire. The contractors and citizens are alike well satisfied with the success of the works.

The Topeka (Kan.) Works.—Messrs. Russell & Alexander, who just finished the Las Vegas Water-works have the contract for building the Topeka Works, and will commence operations as soon as frost is out of the ground. The material is on hand.

New Pumps.—The Cheboygan (Mich.) Water Commissioners have decided in favor of two of Walker's pumps, with a capacity of 1,000,000 gallons each every 24 hours.

Artesian Wells.—Water will be furnished along the line of the Atlantic & Pacific from artesian wells, which can easily be sunk. These wells will give an abundant supply of wholesome, sweet water, which is so scarce in that arid region.

Vote To Build Water Works.—The vote on the water question in Marlboro, Mass., on the 28th ult., stood 635 in favor and 296 against. George H. Norman offers to put in the works at his own expense, the town to pay him $5,000 annually.

Cincinnati Water-Works.—Cincinnati is contemplating the removal of the water-works to Markley Farm, three miles above the present works. The reason for the change is that the city has grown so far beyond the original limit of the system, as laid out 70 coal exposed to the air a long time before being burned. Then the refuse coal will be utilized, and in a hundred other ways will the profits of the company be increased. They expec. to find no difficulty in pumping the gas from the works to the seaboard, as the distance will not be more than 240 miles, which is less than the distance oil is now pumped. There may be a slight loss in the power of the gas, caused by transportation, but this will be more than made up by the rich illuminating qualities of the gas made from fresh coal.

To Build Water-works.—Leavenworth, Kan., has contracted with a company of its citizens for water-works on the reservoir system, after plans prepared by G. W. Pearsons, Chief Engineer Kansas City Waterworks. The work to be completed ,during this year.

Trial of Hydrants.—A satisfactory trial of hydrants of the new water-works at Palestine, Tex., has been made.

Laying Water Pipes.—Water mains are being laid at Atlantic City, N. J., and the works will soon be completed.

A New Water-Works Company is about to be organized in South Denver, Col. Capital, $500,000.

Future Price of Gas in England.—The London *Engineer* expects to see gas sold for 50 cents a thousand feet at a profit.

Water-Works Tunnel.—Chicago's first water-works tunnel, running out under the lake for two miles, was pumped dry recently, and Mayor Harrison, the city engineer and a squad of reporters went through it, ostensibly to examine the masonry. At the distance of 3,900 ft. from the shore a brass plate was nailed to the bricks bearing this inscription: Water let in tunnel, March 24, A. D. 1867. In continuous use 15 years. Pumped out Jan. 18, 1882. Found to be in excellent condition. This record, placed by Carter H. Harrison, mayor of the city of Chicago, Jan. 24, A. D. 1882.

The Ludlow Valve Manufacturing Company, Troy, N. Y., although having enlarged their concern twice last year, are about to make a large addition to the works to accommodate the new machinery now being made for them. They are constantly working on orders.

Gas Explosion.—On the 31st ult. a gasometer of the Citizens' Gas Company, of Newark, N. J., exploded. A large portion of the city is now in darkness. Loss, $20,000.

Preventing Pollution of Mystic Lake.—The Board of Aldermen, of Somerville, Mass., recently received the report of the Board of Health. After stating that no complaints had been received in regard to Mystic water, the report suggests the following in order to keep it pure: "Divert all sewage matter from the lake and its tributaries; provide a proper system of sewerage for the towns of Winchester, Woburn and Stoneham; remove the filth and decayed vegetable matter from the lake and its tributaries; improve the shores of the lake and ponds, and take such measures as may be necessary to prevent the growth of vegetable matter."

ELECTRICITY.

Underground Telegraph Wires.—An effort is being made in Louisville, Ky., to place the telegraph wires underground.

Western Union Extension.—The lines from Corpus Christi to Brownsville, Tex., and from Matamoras to Tampico, Mexico, have been completed.

Bridge Lighted by Electricity.—The Greenbush Bridge, Rensselaer County, N. Y., is to be lighted by electricity.

Will Construct a Line.—The Trenton (N. J.) Common Council has given the Mercer & Burlington Electric Light Company permission to erect poles and wires in that city.

Public Electric Lights.—The Belleville (Ill.) City Council is asked to give permission for electric lights on the streets.

Electric Light Company Organized.—The Brush Electric Light and Power Company, of Memphis, Tenn., has been organized with a capital of $500,000. The new company will have exclusive control of the Brush apparatus for all the nineteen counties of West Tennessee.

Electrical Honors to Americans.—Edison has been made officer of the Legion of Honor, and our Consul-General, Hon. George Walker, is made recipient of the same favor. His son, Mr. Philip Walker, receives the grade of Chevalier for his services as Secretary of the American branch of the Electrical Commission. He is the youngest man but one who ever received this decoration.

A New Telegraph Line has been lately built across the mountains from Manchester to Saxton's River, Vermont, with ten offices on it, in as many country villages.

Electric Light Abroad.—The London *World* says: "The frightful calamity at Vienna—a combination of carelessness, misfortune and an unprecedented absence of mind—renders every step towards making a theatre more or less secure against danger of fire particularly interesting. Mr. D'Oyly Carte gave one day last week the first performance of 'Patience' with the whole stage lit up by electricity. It will, perhaps, less interest the reader to know that two separate engines provide 800 lights for the stage and the dressing rooms, and 129 lights for the auditorium, than to know that the incandescent lamp gives an agreeable, soft, not glaring light, advantageous for the colors, and—mind!—for the complexion; gives no heat, flickers not, smokes not, causes no dirt, and last, not least, cannot set fire to anything it comes in contact with, simply because the incandescent wire, heated white, is inclosed in a glass globe from which the air has been exhausted, this vacuum being one of the conditions of the burning. If, therefore, by any accident the globe should be broken and the flame exposed the mere rushing in of the air would destroy its vital conditions and extinguish it. An *argumentum ad hominem* was furnished, after a clear and intelligent speech to that effect, made between the first and second acts by Mr. D'Oyly Carte, who, to illustrate his words, wrapped one of the globes in the most inflammable material, tulle gauze, and broke the glass; instantly, instead of burning the gauze, the flame was extinguished." With reference to the lighting of railway trains, a correspondent of a Sheffield (Eng.) paper, writing from London of the recent trial of electric lights on the Pullman train of the London, Brighton & South Coast Railway, says: "There is no doubt whatever on the point that this, apart from the question of cost, is a decided success. It is easily manageable, and diffuses through the train a pleasant, equable light, scarcely less agreeable than daylight. It is turned on and off with instantaneous effect as the train enters and leaves a tunnel, and of course is kept burning the whole of the time during the night journeys."

STREETS, DRAINAGE, ETC.

Street Cleaning Contracts.—With the approval of the Highway Committee of Councils, of Philadelphia, Commissioner Baldwin has awarded contracts for street cleaning as follows for the ensuing year: Joseph Johnson & Co. will do the work in the First district for $53,000; Second, $45,000; Third, $71,250; Fourth, $49,950 and Seventh, $15,900. The Fifth district will be cleaned by W. B. Conklin for $6,400 and the Eighth for $10,890. The Sixth district was awarded to E. S. Longee at $10,700. The contract for repairing sewers and inlets north of Market street was awarded to W. H. H. Achoff for $8,900; for the district south of Market street to the same bidder for $5,900.

To Enforce Sanitary Rules.—A committee of the Wilkesbarre, Pa., Councils has drafted an ordinance to enforce sanitary rules in the city.

Dorchester Bay Tunnel.—The tunnel under Dorchester Bay for the improved sewerage system is being excavated at the rate of 42 ft. per week, and 800 ft. is all that remains. It will probably require about five months to complete the work.

Sewerage in Cincinnati.—Mr. W. H. Baldwin, who has been examining the sewers of Cincinnati under the direction of the U. S. Census Bureau, says that where the system is completed the sewers were well ventilated and supplied with a large flow. There is a portion of the city not sewered where the earth is gradually becoming saturated with filth.

RIVERS AND HARBORS.

The Projected Harbor Improvements at Lynn, Mass., will, according to Gen. Thom's report, cost about $600,000. Two rubblestone break-waters will be built, and the Black Rock channel, as also the Saugus River channel, will be straightened, widened and deepened.

An Iron Pier is to be built at Atlantic City, N. J.

Break in a Mississippi Levee.—A break of 100 ft. is reported in the O'Brien levee, at Tropical Bend, a little above the Quarantine station, but on the opposite side of the river. The country is said to be inundated for two miles back.

New Jersey Flats.—The reports of the government engineers on the examination of the New Jersey flats in New York harbor, made with the view of determining the feasibility and cost of constructing a ship-canal, extending from a point between Ellis Island and the docks of the Central Railroad of New Jersey to a point between Constable Hook and Robbin's Reef, have been sent to the Senate. Assistant Engineer Doerflinger, who was specially detailed to make the examination, reports on the main question as follows: "To obtain access to the deep water of New York harbor, it is the desire of the owners of the land bordering on the flats and of others interested in the utilization of the flats for the purposes of trade and commerce that a ship canal be constructed about 500 ft. outside of the pier line as at present established from the docks of the Central Railroad to Craven's Point, the channel to continue in a straight line to the deep water of Kill von Kull. The Riparian Commissioners of the State of New Jersey propose, should the construction of the channel be undertaken by the United States, to establish a new pier line to coincide with the westerly limits of this channel, so that the future pier-heads will thus be accessible from the navigable waters of the Bay. In addition to affording a means of deep-water communication between future piers that may be built on the flats and the navigable waters of the harbor, the channel would somewhat shorten the distance from points on the Hudson River to points on the Kill von Kull, and would afford a more sheltered water-way to the numerous tows now plying between these points, and the one more free from strong head currents than the main ship channel." Accompanying Assistant Engineer Doerflinger's report is a detailed estimate of the cost of the proposed channel—21 ft. deep at mean low water and 300 ft. wide at the bottom—which places the total cost at $7,134,980.

CANALS.

The Chesapeake & Ohio Canal Company has been requested by the presidents of the various coal companies to so arrange its work during the present winter in the matter of lengthening locks, etc., that it will be completed by spring.

The Interoceanic Canal.—The sub-committee of the House Committee on Commerce, in charge of the several bills which have been introduced in regard to an interoceanic canal, met recently, and agreed to report favorably to the full committee Mr. Gibson's bill, which provides for the appointment of an interoceanic commission to determine the best plan and route for the establishment of communication between the Atlantic and Pacific oceans. It authorizes the President to appoint the Commissioners—one from the navy, one from the army, one from the Coast and Geodetic Survey, and two from civil life. Mr. Buckner's bill to incorporate the Interoceanic Ship Railway Company, which is in the interest of the plan proposed by Capt. Eads, was considered by the sub-committee, and an unfavorable report agreed upon.

Western Canal Projects.—A project to build a ship canal across the State of Michigan, from Saugatuck to Detroit, has been brought before Congress. Estimated cost $5,554,900. The length would be 178 miles. Ten thousand dollars is asked for a preliminary survey. Another project is that of building a canal from Rock Island, on the Mississippi River, eastward 65 miles to Hennepin, on the Illinois River. The Illinois & Michigan Canal extends from Chicago westward to Peru, which is only a few miles from Hennepin, and the connecting link between the old and the new canal would be formed by the navigable waters of the Illinois River. It was estimated in 1870 by the War Department that the Hennepin Canal would cost $3,900,000. A glance at the map shows that this canal would establish communication between the Mississippi River and the great lakes. It also appears that the proposed canal across the base of the Michigan Peninsula would open water communication on almost a straight line from Chicago, through Lake Erie and the Erie Canal, to New York.

RAILROADS.

Engineers contemplating a trip to Mexico in search of employment are warned against going at present. The Mexican National Company, as it is well known, are in at least temporary difficulty financially, and have reduced their forces to lowest possible limit. It is to be hoped that work will be resumed in full very soon, but until more cheerful news comes to us from Mexico, we advise all engineers to give up thoughts of going thither if employment is their object.

Rails Ordered.—The Troy & Lansingburgh Railroad has ordered 200 tons of rails to be used in repairs during the year.

Branch of the A., T. & S. F. R. R.—The running of a branch road from Las Cruces, N. M., into the Organ Mountain mining camp is now being considered by the Atchison, Topeka & Santa Fe Railroad Company, and a branch will also be run from Engle into San Andreas, if the mining enterprise in that range shall warrant it.

The C. & C. R. R. Extension.—The Carson & Colorado Railroad is to be extended during the year 1882 in a southwesterly direction into California, following through Owens Valley to a connecting point with the Southern Pacific Railroad.

Iron Freight Cars.—A party lately visited the Gilbert & Bush Car Works and examined some iron freight cars built by that company. These iron cars, it is calculated, will be from 2,000 to 3,000 pounds less in weight, and a consequent saving in dead weight will be obtained, which at a half a cent a mile for transportation would pay for an ordinary car in two years. The cars are all iron below the platforms, being composed of malleable iron tubes, through which iron rods pass to add strength to the truss work. Many of the different parts of these cars, which according to the old wood cars were cast iron, are made of malleable iron, and are much lighter, not being made nearly as large or thick.

The River Front Railway along Delaware avenue, Philadelphia, which is intended to form a circuit around the city for the transfer of freight is almost completed.

Spuyten Duyvil Accident.—The indictment of the railroad company by the jury is very severe, yet most of its recommendations will meet with the approval of the public. Greater precautions are needed on the railroads. This disaster and the judgment of the jury will move their managers to adopt a more liberal policy, while legislative enactment will compel them to introduce certain improvements and safeguards. As to fixing the direct responsibility and punishing the guilty, this matter is now in the hands of the law, where it is likely the question will be definitely settled.—*Albany Evening Journal.*

Completed Survey of the F. S., St. L. & C. R. R.—The Ft. Scott, St. Louis & Chicago Railroad have completed the survey of their line from the Chicago & Alton road to Fort Scott, and the engineers are now engaged in making the profiles and maps of the line and an estimate of the work.

Canadian Pacific Railway.—Mr. C. Drinkwater, Secretary of the company, makes the following statements under date of Jan. 19: That it is the intention of the company to push the work of construction from Winnipeg westward with the utmost possible vigor during the coming season, with the object of opening the country for settlement as early as possible, and to facilitate the transport of men and material to the heavier work in the Rocky Mountains, which it is the purpose of the company to attack simultaneously from east and west in the spring of 1883. To accomplish this the company will have to perform a feat unparalleled in railroad history, of laying the rails on 500 miles of track on one continuous line in six months. * * * The Pembina Mountain branch, which was partially graded last year, will be completed and ready for operation in time to move the coming season's crops. The work on the eastern section of the main line is now being prosecuted at two points, and with as large forces as can be economically employed. As surveys are completed, and on the opening of spring, the forces will be added to. It being the intention of the Company to keep the line as near the shore of Lake Superior as possible, it is expected that other points will be available for placing the work under contract. The adoption of the new alignment will shorten the Sault Ste. Marie branch, and will open Algoma Mills, and probably other points on the lakes, for traffic with Chicago and other important business centers, as well as with Thunder Bay, pending the completion of the all-rail route, which, it is estimated will occupy five years in construction. The construction of the Sault Ste. Marie branch thus reduced in length to about 60 miles from the proposed point of junction on the main line, will be hastened instead of retarded by the change, it being the settled purpose of the Company to build the line without delay, and to connect with all and every railway that can exchange traffic with it at the international boundary. The company proposes to use the Thunder Bay branch, so soon as it is handed over by the Government, for all the Northwest traffic, both passenger and freight, that it can influence, and no arrangement has been entered into with any railway in the United States or Canada that could in any way interfere with that design. The company, recognizing the necessity of having its main Eastern terminus at Montreal, will take occasion as opportunity offers to arrange with existing or proposed railways for its traffic between this point and its main line; but the company has no connection with and no intention of being interested in any railway project east or south of Montreal or west of Perth.

The C. V. R. R. Extension Abandoned.—The Connecticut Valley Railroad Company have given up the plan of an extension to Holyoke, and will only build from Hartford to Springfield at present.

Track-laying on the road from Knobel, Ark., to Alexandria, La., is progressing at the rate of 20 miles per month. Grading and bridging 15 miles ahead of the end of iron. On the resignation of Henry McLaughlin, J. M. Jackson, of Schenectady, N. Y., was appointed Chief Engineer and Superintendent of construction. This road is one of the Gould system, and is built by the Hudson River Contracting Co., and it completes the system of light grades between Chicago and New Orleans.

Moving Machine Shops.—The Maine

Central Railroad Company will remove its machine shops from Waterville to Portland, Me., bringing with is fully 1,000 people.

Reading R. R. Branch.—The Reading Railroad Company will build a branch road from Shamokin to Danville, Pa., length, 15 miles.

N. Y., P. & C. R. R.—Delos E. Culver, Vice-President and Chief Engineer of the New York, Pittsburgh & Chicago Railroad, is traveling along the line of that road, looking after its interests. The road will extend from Tamanend, Pa., on the New Jersey Central, to Marion, O., on the Chicago & Atlantic. The road will pass through Stark County about 12 miles south of Canton, and probably cross the Pittsburgh, Ft. Wayne & Chicago at Wooster. It is already built from Tamanend to Wampum, Pa., and work is progressing westward.

Extension of the U. & D. R. R.—The project of extending the Ulster & Delaware Railway from Stamford, its present western terminus, to Cooperstown, N. Y., a distance of 28 miles west, is being again agitated and will probably result successfully.

Branch from Milan to St. Joseph.—Preparations are making to build an extension of the Quincy, Missouri & Pacific Division of the Wabash road from Milan to St. Joseph.

Rumored New Line.—A new railroad is talked of from Lynchburg, Va., by way of Bedford, Franklin, Floyd, Carroll and Grayson counties, to Ashe County, North Carolina. It is expected that a company can be organized to carry out the enterprise.

A street railroad company has been formed at Lexington, Ky., and the Legislature has been asked for a charter.

Snow-sheds.—The wonderful snow-sheds—tunnels—on the Central Pacific Railroad are of two kinds, one with very steep roofs and the other with flat roofs. They cost per mile from $8,000 to $12,000, and in some places where heavy masonry was needed the cost reached $30,000 a mile. They are firmly constructed to support the great weight of snow and resist the rush of avalanches. Fire precautions are very thorough. Corrugated plates of iron separate the buildings into sections, and in the great ten-mile section there are automatic electric fire-alarms. At the summit is an engine and tank always ready to flood the ignited spot in a moment. These sheds shut in the view of the great Sierras, but without them travel would be impossible. Sometimes 5 ft. of snow falls upon them in a day, and often 30 ft. lie on the ground at one time, and in many places snow accumulates to the depth of 50 ft. above these great wooden arches.

New Mexican Railways.—Within the past three months General John B. Frisbie, agent of Mr. C. P. Huntington, in Mexico, obtained the following modifications to the railroad franchise be had a short time before obtained from the Mexican government. The line to be constructed from the City of Mexico to the Rio Grande frontier will have its terminus at Piedras Negras, or some other point, twenty-five leagues either to the east or west of that town. The company has also obtained the privilege to construct another road, from such point on the trunk line as they may deem most convenient, to a point on the gulf coast between Matamoras and Vera Cruz. Beside this liberal grant, the company is authorized to build yet another line, from the trunk road west to the Pacific coast, which will have its terminus at some point between Mazatlan and Zihuatanejo. Finally the syndicate is granted the right to construct all the branch roads, on either side the main trunk line, they may deem proper to undertake. The termini on either coast are to be erected into ports of entry, and the Federal Government will establish a frontier custom house on the Rio Grande at the terminus of the main line. General Frisbie also obtained another concession, which he has since transferred to Mr. Huntington, for a line skirting the eastern coast of the Gulf of Cortez, and of the Pacific, along the seaboard of the states of Sonora, Sinaloa, Jalisco, Colima, Michoacan and Guerrero. This line will establish rail communication between the principal western seaports, while the impresario has the privilege of building branch lines from the ports of Mazatlan, San Blas and Manzanillo into the interior. Both lines are to be of the standard gauge and without subsidy.

Mexican National.—Work is progressing rapidly on this line towards Lampazos.

Canadian Pacific Consolidation.—The lines of the Canadian Pacific Railway have been consolidated in such a way that all west of Lake Superior to the Pacific coast will be known as the Western division, and all east to the intended Atlantic terminus as the Eastern division.

New York R. R. Surveys.—The survey of a new railroad in Washington County will be completed by the 20th of February. The road will extend from Greenwich to Whitehall, 42 miles, and will pass through Salem, Hebron, West Pawlet, Granville, Mid-

Continued on page V.

P. A. COLLINS, President. JOHN D. GOULD, Treasurer and Manager

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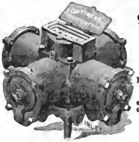

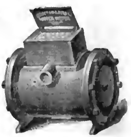

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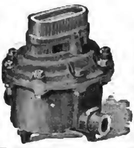
BALL & FITT'S PISTON WATER METERS,
AND
B. FITT'S ROTARY PISTON WATER METERS



These meters are entirely different in principle, except that both are positive in measurement. 15,000 meters made by this company are in use in the United States and Canada with the most satisfactory results. Trial meters will be sent to any Water Company for tests. Catalogues, price-lists, etc., furnished on application. Also manufacturers of

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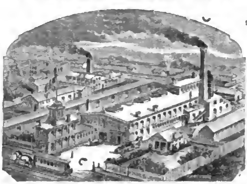

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Continued from page IV.

die Granville and North Granville. A survey of a new road from Middle Granville to Rutland, Vt., will be commenced when the survey of the Greenwich & Whitehall road is finished. The route from Middle Granville will be through Raceville, Poultney, Castleton, West Rutland and Center Rutland. The iron mills along Lake Champlain will be connected by boat with the new railroad. The road from Greenwich to Rutland and Whitehall will be built at a cost of $22,000 per mile.

NO OIL.—Train employés on the Ce ntra railroad complain that they are not allowed sufficient oil to keep their red lamps burning. On the eastern division oil can only be obtained at Albany, and on the western division at Syracuse. A brakeman in conversation with a reporter the other evening, said: "You can see for yourself. My red lights are burning so low that they would go out if I had to run back and swing up a train. We have asked for oil at Syracuse or a can to carry some from Albany, but both are refused. To guard against accident, my conductor has advised me not to keep my red lantern burning, but trust to lighting it when needed. If a dangerous stop was made, a train might collide with us before I could light the red light. The conductors' and brakemen's white lights will not last from Albany to Syracuse. Look at my dull red light; that is the best answer. A conductor was obliged to go out in Syracuse and buy oil enough to carry him and his crew to Albany the other night. We can't afford to buy oil or oil cans at our wages. All crews following other trains closely are afraid that they will have a fearful wreck for want of a little oil where it is needed. We must have oil to fill our red danger-lamps anyway. The company never was known to be stingy with oil before this winter. It is probably one of the new 'reforms' we hear about." If this is the case, if the New York Central railroad is willing to risk the lives of its employés and passengers for the sake of saving a few gallons of oil, the people want to know it at once. The accident at Spuyten Duyvil is opening the eyes of many persons who have heretofore supposed that in case of accident the employés were the only ones to blame. The railroad company is now being arraigned at the bar of public opinion, charged with not taking proper precaution to insure the safety of its passengers. The people will say whether it is guilty or not guilty.—*Watertown, N. Y., Times, Jan. 20.*

A NOVELTY.—We are pleased to see by the following advertisement that the profession is not overdone, as yet. Who ever heard of an advertisement for a lawyer to take charge of a case, for a general of an army, or indeed for a boss of any kind. We are glad that the supply appears still to be in advance of the demand:

WANTED.—In a British Colony, a Chief Engineer for railway 500 to 600 miles long, partly in operation and partly to be constructed. He must be thoroughly competent, energetic and experienced in railway location, construction, repairs and maintenance, and of high personal character. Address, stating age and record in detail of professional career, names of works engaged upon, employers, references and terms.

"RAILWAY," care of *Railroad Gazette*,
73 Broadway, New York.

WANTED.—In a British Colony, a General Superintendent for a railway now about 400 miles long, but to be about 500 and 600 miles long hereafter. He must be thoroughly competent, energetic and experienced in all that pertains to the management of traffic, and of good personal character. Address, stating age, record in detail of career, railways employed on and time: also references and terms,

"RAILWAY," care of the *Railroad Gazette*,
73 Broadway, New York.

BUILDING.

THE Delamater Iron Works, of this city, are employing at the present time 1,000 men, and are putting up a new building, 50 x 206 ft., which will be stocked with tools for a machine shop.

NOTICE TO ARCHITECTS.—The Building Committee of the Board of Regents of the State University of Texas invites designs for the proposed main building of the university to be built in Austin. Particulars can be obtained from Dr. T. D. Wooten, Box 202, Austin, Texas.

JAIL CONTRACT LET.—The contract for building a county jail at Uvalde, Tex., has been let to Mead & Lindel, of San Antonio, for $10,550.

PROPOSALS FOR CITY HALL AND MARKET.—The Omaha, Neb., city council has appointed a committee to receive proposals for building a city hall and market.

APPROPRIATIONS FOR BUILDINGS.—To the House Committee on Public Building and Grounds has been referred bills for the erection of custom-houses and post-offices aggregating a cost of $12,000,000.

BUILDING WHARVES AND GRAIN ELEVA-

Continued on page IX.

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VALVES & GATES.

FIRE HYDRANTS

WITH OR WITHOUT

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ALL VALVES AND HYDRANTS

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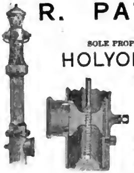

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HOLYOKE FIRE HYDRANT.

THE MOST RELIABLE AND DURABL HYDRANT MADE.

Warranted not to freeze in any climate, as it drips two inches below the bottom of main pipe.

For further information address the Manufacturer.

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Price, $3.00.

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PEET VALVE CO.,

Manufacturers of Patent

STRAIGHT WAY VALVES

FOR

STEAM, WATER, GAS,

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METROPOLITAN IRON WORKS.

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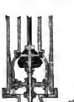
Our Patent Improved Fire Hydrant is guaranteed NON-FREEZING, has ample water way, simple, reliable waste valve, draining water in stock absolutely down to valve. Built with special tools, both encased like cut and without cases. Interchangeable in all their parts, and fitted with as much care as is bestowed on engines and work of that class. Making a specialty of Water-Works Fixtures.

We are prepared to furnish Hydrants, all sizes and styles, Improved Stop Cocks, from 4 in. to 48 in. diameter, at lowest prices consistent with first-class workmanship and material.



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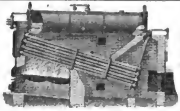

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FROM TWO TO FORTY-EIGHT INCHES DIAMETER.

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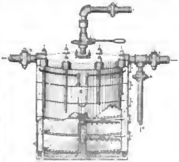

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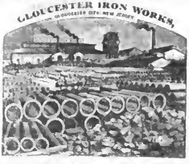

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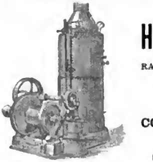

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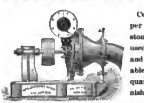
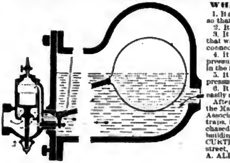
CENTRIFUGAL PUMPS & HOISTING ENGINES



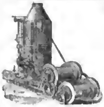
Centrifugal Pumps, capacity of from 100 to 60,000 gallons per minute. Will pass from 30 to 40 per cent. of coal, gravel, stone, sand, or other foreign substances, and are extensively used in dredging, wrecking, mining, irrigation, water-works and sewerage. Hoisting Machines of all sizes and styles suitable for contractors, railroads, bridge-builders, coal yards, quarries, etc. Complete outfits, with all appurtenances, furnished at short notice.

THE CURTIS STEAM TRAP.



WHAT WE CLAIM FOR IT
1. It automatically discharges all the air, so that none can accumulate in the trap.
2. It is noiseless under all pressures.
3. It will deliver with such freedom that water can never accumulate in the connecting pipes.
4. It will discharge against any back pressure, less than the direct pressure in the trap.
5. It will work equally well under any pressure.
6. It is simple in its construction and easily accessable for cleaning.

After exhibition in the recent fair of the Massachusetts Charitable Mechanics' Association, in competition with other traps, the Curtis Steam Trap was purchased for permanent use in the exhibition building. Manufactured and sold by THE CURTIS REGULATOR CO., 59 Beverly street, Boston, Mass. Send for Circular. A. ALLEN, Agent, 109 Liberty st., N. Y.



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OF ANY POWER AND STYLE,
DOUBLE AND SINGLE CYLINDER
WITH
IMPROVED PATENT FRICTION DRUMS,
especially adapted for Bridge Building, Dock Building, Pile Driving Coal Hoisting, Quarries, Mines, etc.
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Steam Hoisting Engines for Furnaces Mines Etc.
STATIONARY STEAM ENGINES, ETC.

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A. WYCKOFF
ELMIRA, NEW YORK.

MANUFACTURER OF
WOOD WATER PIPE.

Continued from page V.

ticking his head out of the car window. "Keep your head inside," said the conductor, angrily. "Whaffor!" "For fear you will damage some of the iron-work of the bridge, you fool."—*Texas Siftings.*

BRIDGING RED RIVER.—The by-law granting $75,000 as a bonus to the Canadian Pacific Railway Company for the construction of a bridge over Red River and eighteen miles of track to connect Emerson with the Pembina Mountain branch, has been ratified at a public meeting of the electors in Winnipeg. There was not a dissenting voice.

BRIDGE BURNED.—The bridge over the James River, Va., of the Richmond & Petersburg Railroad was destroyed by fire on the 26th ult., nothing being left but the granite piers upon which it rested. The bridge was originally built in 1838, and was destroyed by fire at the time of the evacuation of Richmond and rebuilt in 1866. It was a Howe truss structure of the old style, with a frame trunk about eighteen feet deep, upon which the track was laid. To the combustible nature of the bridge, combined with the high wind, was due its swift destruction. The loss is $160,000. The fire did much damage to manufacturers in the neighborhood.

APPROPRIATIONS BY CHICAGO.—The Aldermen have appropriated $15,000 for a starter for a bridge over Taylor street, and $10,000 over Deering street.

Viaducts.—The items of $50,000 for a viaduct at Chicago avenue and Halsted street, and $40,000 for one over Centre avenue, recommended by the Committee of the Whole, were adopted.

LITERATURE.

HINTS FOR PAINTERS AND PAPERHANGERS is the latest of the "Work Manuals" published by the Industrial Publication Co. of this city. It is a selection of useful rules, data, memoranda, methods and suggestions for house, ship and furniture painting, paper-hanging, gilding, color mixing and other matters useful and instructive to painters and decorators. Price, 25 cents.

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Continued on page X.

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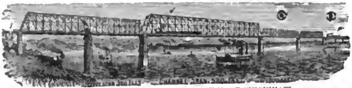

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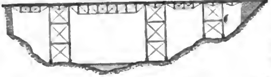

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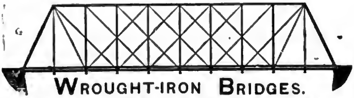

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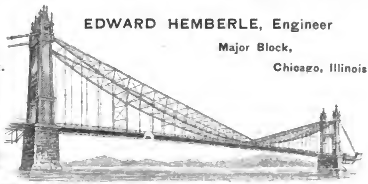

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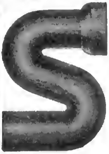

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Continued from page VII

CONTRACTS FOR IMPROVEMENTS in Mitchell, Dak., have been let to the amount of $300,000.

A BRICK-MAKING COMPANY has been formed at Yankton, with a capital of $32,000.

THE Contractors' Plant Manufacturing Company, of Buffalo, N. Y., in their combined derrick horse-power and boom-hoister, certainly offer a very greatly improved appliance over the machinery now in use for handling heavy masonry. Mr. A. E. Dobbie, the inventor, has subjected it to long and severe tests before offering it to the public, and the testimonials concerning it are of the most satisfactory character. From a personal examination of a model of the machine we are prepared to indorse the testimonials, so far as a model will allow us to judge of the working of a full-sized machine. The company have fully protected the machine by patents. They have issued a very handsome colored card, which will be sent framed or unframed to any address on application.

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SITUATION WANTED as an Assistant Engineer; New England or Middle States preferred. Will furnish transit set if desired, and work one month on trial. Address, stating character of work and salary,
13-4t W. E. BUCK, Woburn, Mass.

A CIVIL ENGINEER OF MANY years' experience in the construction of railroads, water-works and sewage works, both in England and Canada, and who has just returned from a ten months' engagement on the construction of an extensive new road in Iowa, is now open to an engagement.

The advertiser was for several years engaged as contractor's chief engineer and agent on extensive railroad works in Ireland. Address A. T. COTTERELL, 195 Dearborn avenue, Chicago.
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Wanted 25 Stone Cutters on the New York, West Shore & Buffalo Railroad at Haverstraw, N. Y. Wages, $3 per day. Work, bridge masonry; job will last six months. Stone are red sandstone. Boat leaves New York from foot of Harrison street, at 3 p. m., and from Peekskill on New York Central & Hudson River Railroad at 6:30 a. m. and 5 p. m. for Haverstraw.

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SITUATION WANTED, after April 1, by a CIVIL ENGINEER. Has had sixteen years' experience in surveying and engineering. Can take charge of railroad location or construction. Address P. O. Box 170,
11-8t NEWTON, SUSSEX CO., N. J.

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PROPOSALS.

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PROPOSALS FOR FURNISHING MATERIAL AND DOING THE WORK.

OFFICE OF THE COMMISSIONERS OF WATER,
READING, PA., March 29, 1882.

The Commissioners of Water of the City of Reading will receive proposals, at the office of the Secretary, City Hall, until 5 p. m. Tuesday, April 11, 1882, for furnishing the material and doing the work necessary to construct a twenty-five million gallon reservoir, on the Hampden Spring property, to be known as the Hampden Distributing Reservoir.

Plans and specifications can be seen and blank forms of proposal procured at the office of A. Harvey Tyson, City Engineer, between the hours of 1 and 4.30 p. m., each day, until the time of letting.

A cash deposit of five hundred dollars with the City Treasurer is required of each bidder.

Bidders are requested to carefully and thoroughly examine the plans and specifications before bidding, as strict and entire conformity thereto will be required.

☞ The Commissioners reserve the right to reject any or all bids.

By order of the Board.

WM. R. McILVAIN, President.
JOHN H. KAPPELMAN, Secretary 13-1t

Proposals for the Construction of Sewers.

OFFICE OF CITY CLERK, OMAHA, Neb., 1882.

SEALED PROPOSALS will be received at the office of the undersigned until Tuesday, April 18, 1882, 12 o'clock noon, for the construction of sewers in North Omaha, as follows: 1,000 ft. of 8½ ft. brick sewer, 728 ft. 5½ ft. brick sewer, and 728 of 3¼ ft. brick sewer, located on Izard street, between Fifteenth and Seventeenth, and on Seventeenth between Izard and Nicholas, between Seventeenth and Twenty-first streets, together with all necessary manholes, lamp-holes, and catch basins, as per plans and specifications in the City Engineer's office. Proposals to be prepared upon blanks furnished by the City Engineer. Bids will also be received for the construction of a timber outfall, embracing the furnishing and driving of 100 oak piles, more or less, 25 ft. long, 12 to 8 in., and 1,500 ft of oak lumber, as per plans and specifications in the Engineer's office. Work to begin on or before June 1, and to be completed December 1, 1882. Payments to be made monthly in cash warrants, 15 per cent. to be reserved until final completion and acceptance of work by the proper authorities. All bids to be accompanied by the signature of proposed sureties, who will in event of awarding of contract enter into bonds of the city for execution of the work in the sum of $30,000.

J. J. L. C. JEWETT,
13-2t City Clerk.

SEALED PROPOSALS will be received at the office of the Board of Public Works, Cincinnati, O., until 12 noon of FRIDAY, April 14, A. D. 1882, for the improvement of Harrison avenue, from Westwood avenue to the Cincinnati, Hamilton & Dayton Railroad, by grading, setting curbs and crossings, flagging gutters, bowldering the roadway and constructing the necessary culverts, drains and retaining walls, according to specifications on file in the office of the Board of Public Works. The same to be paid for in cash within two weeks after the bonds to be issued in payment for this improvement shall have been sold.

The Board reserves the right of rejecting any or all the bids.

Bidders will indorse their names and address upon the outside of the envelopes containing their bids.

Each bid to be accompanied by two disinterested sureties.

Bidders to use the printed forms, as none other will be received.

By order of the Board.

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KENTUCKY CENTRAL RAILROAD,
SUPERINTENDENT'S OFFICE,
COVINGTON, Ky., March, 1882.

SEALED PROPOSALS will be received until April 15, 1882, for the building of three or more Passenger Stations on the Kentucky Central Railroad, as per plans and specifications on file at this office. The right is reserved to reject any or all bids.

J. D. ELLISON, Gen'l Manager. J. H. SETCHEL, Superintendent.

Construction of Reservoir for System of Water Works.

OFFICE OF CITY CLERK,
RED OAK JUNCTION, Iowa, March 20, 1882.

SEALED PROPOSALS will be received by the City Council of the City of Red Oak Junction, at Red Oak, Iowa, until 7 o'clock p. m., Thursday, April 20, 1882, for the construction of a reservoir to complete the system of water-works adopted by the City Council of said city. Bids will be received for the construction of a reservoir of one million gallons capacity, and for reservoir of the capacity of one and one half million gallons capacity. Parties making bids will submit their own plans and specifications, stating of what kind of material, etc., said reservoir will be constructed. Proposals may be addressed to City Clerk or Chairman of Water-Works Committee, Red Oak, Iowa.

THOMAS H. LEE, City Clerk.

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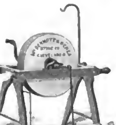
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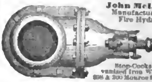

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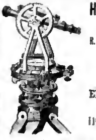

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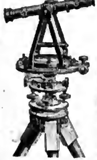

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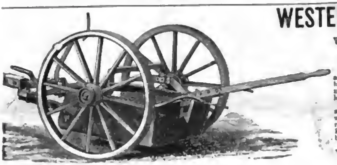

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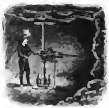

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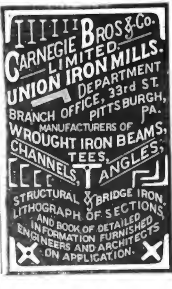

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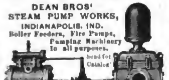

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